Essays on Bond and Commodity Markets

DISSERTATION

zur Erlangung des akademischen Grades
doctor rerum politicarum
(Doktor der Wirtschaftswissenschaft)

eingereicht an der

Wirtschaftswissenschaftlichen Fakultät
der Humboldt-Universität zu Berlin

von

Master of Science Elina Pradkhan

Präsident der Humboldt-Universität zu Berlin:
Prof. Dr. Jan-Hendrik Olbertz

Dekan der Wirtschaftswissenschaftlichen Fakultät:
Prof. Dr. Ulrich Kamecke

Gutachter/Gutachterin: 1. Prof. Dr. Sigrid Müller
2. Prof. Dr. Dr. h.c. Franz Hubert

Tag des Kolloquiums: 15.06.2016

Contents

Introductory Summary 1
References 10

Impact of Domestic Creditor Protection on Foreign Bond Bias 13
1 Introduction 14
2 Related Literature 16
3 Data and Methodology 18
3.1 Data 18
3.2 Methodology 23
4 Results 27
5 Conclusion 33
References 37
Appendix 40

Impact of Culture and Patriotism on Home Bias in Bond Portfolios 51
1 Introduction 52
2 Related Literature 53
3 Data and Methodology 55
3.1 Domestic and Foreign Bias 55
3.2 Culture and Patriotism 57
3.3 Methodology 63
4 Results 66
4.1 Domestic Bias 66
4.2 Foreign Bias 70
5 Conclusion 73
References 75
Appendix 78

Financialization of Agricultural Futures Markets: Evidence from Quantile Regressions 89
1 Introduction 90
2 Literature Review 92
3 Index Traders, Money Managers and Other Reportables 95

4 Data and Methodology 98
4.1 Data 98
4.2 Methodology 100
5 Results and Discussion 106
5.1 Granger Causality in Mean versus Granger Causality at Individual Quantiles 106
5.2 Direction of Granger causality 108
6 Conclusion 112
References 114
Appendix 119

Impact of Speculation on Precious Metals Futures Markets 129

Information Content of Trading Activity in Precious Metals Futures Markets 130

Introductory Summary

The dissertation "Essays on Bond and Commodity Markets" deals with determinants of investment decisions in bond markets and with speculation and information content of trading activity in commodity futures markets. The two essays on bond markets contribute to the explanation of the home bias phenomenon by studying two aspects of the financial decision making that have not been explored in the context of home bias in bond portfolios yet:

(i) How do culture and patriotism impact domestic and foreign debt portfolio allocation decisions?

(ii) What is the role of domestic creditor protection in foreign debt portfolio allocation decisions?

The essays on commodity markets deal with financial activity and its information content in agricultural and precious metals futures markets. The most important contributions to the existing literature are as follows:

(i) examination of Granger-causal effects of trading activity of speculators and index traders at different quantiles of the return distribution, which explicitly introduces non-linearity in the relationship between returns and trader positions in agricultural futures markets;

(i) in-depth analysis of the role of speculative activity in precious metals futures markets, in which hedging pressure is explicitly included in Granger causality tests;

(ii) exploration of the forecasting power of trading activity and its information content in precious metals futures markets based on a regime-dependent approach that allows identifying informational and non-informational trades in bull and bear market states.

The essay **"Impact of Domestic Creditor Protection on Foreign Bond Bias"** analyzes the relationship between domestic creditor protection and foreign investment in bond markets. The role of domestic investor protection in the cross-border investment decisions in debt markets has been neglected in the empirical and theoretical research on home bias in bond markets: The existing studies that strive to explain the cross-border bond investment focus on creditor protection in destination countries (e.g. Fidora et al., 2007; Ferreira and Miguel, 2011; Giofré, 2013). By contrast, for equity markets, several concepts have evolved that relate domestic shareholder protection to foreign investment. The "good country bias" theory of Giannetti and Koskinen (2010) predicts that shareholders who benefit from a high level of investor protection at home have less incentives to diversify their portfolios internationally than shareholders from countries where their rights are only insufficiently protected. To put it differently, shareholders implicitly compare foreign and domestic creditor protections when determining portfolio shares allocated to foreign stocks (Giannetti and Koskinen, 2010). Similarly, the "comparative

corporate governance" theory of Giofré (2014b) implies that domestic shareholder protection plays the role of a benchmark against which the foreign shareholder protection is evaluated. Empirically, a twofold effect of domestic corporate governance on foreign investment decisions is documented (Giofré, 2014a). On the one hand, efficient domestic corporate governance increases foreign equity investment (positive direct effect). On the other hand, it reduces the sensitivity of foreign equity investment to the shareholder protection in the destination country (negative indirect effect).

My study shows that the theoretical concepts and empirical findings for equity markets cannot be applied to the bond markets unrestrictedly. The empirical results for bond markets lend little support to the "good country bias" and the "comparative corporate governance" theories. Domestic creditor protection does not appear to be a benchmark against which the creditor protection in the destination country is evaluated. On the contrary, the effect of domestic legal environment is more decisive compared to the host's one: The positive effect of domestic creditor protection on foreign investment is so strong that it dominates the positive effect of the foreign creditor protection. However, the difference between domestic and foreign creditor protections impacts the cross-border bond investment in the sense that it affects the *sensitivity* of foreign investment to creditor protections in home and host countries. If domestic creditor protection is more efficient than foreign creditor protection, the sensitivity of foreign investment to foreign (domestic) creditor protection decreases (increases). These findings are closely related to the negative indirect effect of domestic shareholder protection as documented by Giofré (2014b) for equity markets.

When the methodology of Giofré (2014b) is applied to bond markets, the reduced responsiveness to the creditor protection in destination countries is documented for the total sample and for investing countries where the protection of creditor rights is relatively high, i.e. above the world average. The ascertained negative effect of domestic creditor protection on the sensitivity of foreign investment to the creditor protection in destination countries indicates that domestic creditor protection may impede the foreign investment: An efficient domestic creditor protection reduces incentives to pay attention to the level of creditor protection in a destination country. This effect is, however, alleviated by the positive direct effect of domestic creditor protection on foreign investment. In spite of its negative impact on the sensitivity of foreign investment to the creditor protection in the destination country, a high level of domestic creditor protection is associated with a higher international diversification in bond portfolios.

However, in countries with a comparatively low protection of creditor rights, domestic creditor protection does not affect the foreign investment's sensitivity to creditor protection in destination countries. Furthermore, a high level of domestic creditor protection makes foreign

investment less attractive. In this case, the negative direct effect of domestic creditor protection on foreign investment challenges the typical explanation of home bias in terms of diversification costs that investors face vis-à-vis foreign assets. It seems that not only host country-specific characteristics such as an inefficient protection of creditor rights and a low quality of legal environment deter the foreign investment, but also that the perception of domestic legal environment may implicitly increase diversification costs and become a barrier to the foreign investment.

These findings have important economic and political implications. The real effects of government measures aiming at attracting foreign capital flows may turn out lower than expected. For instance, trying to improve creditor protection in the hope of increasing foreign investment in domestic bonds may not achieve the desired outcome if investors from countries where their rights are well protected do not pay much attention to the creditor protection in the destination country.

In the existing studies that deal with the determinants of home bias in bond markets, a lot of attention is paid to neoclassical explanations. By contrast, the essay **"Impact of Culture and Patriotism on Home Bias in Bond Portfolios"** enlarges the empirical literature on home bias of bond investors by analyzing the impact of patriotism, individualism, uncertainty avoidance and cultural distance on domestic and foreign bias in bond markets. Domestic bias reflects the overinvestment in domestic debt securities, whereas foreign bias captures the bilateral under- or overinvestment.

Portfolio allocation decisions may be governed not only by objective decision criteria such as risk and return considerations, but also by investors' subjective beliefs that are closely linked to cultural inheritance. Patriotism, individualism, uncertainty avoidance and cultural distance are related to psychological and behavioral characteristics that influence human behavior and may also affect investment decisions. For instance, investment in domestic securities may yield additional utility to patriotic investors (Morse and Shive, 2011). Familiarity bias may manifest itself more strongly in the presence of cultural similarities between home and host countries resulting in a higher preference for those foreign securities that are issued in countries that are culturally similar to the home country. Uncertainty avoidance is closely related to intolerance of ambiguity (Hofstede et al., 2010; House et al., 2004) that results in a reluctance to invest in the less familiar foreign assets. By contrast, overconfidence as a behavioral underpinning of individualism is supposed to induce investors to take higher risks (Chui et al., 2010) and, thus, to boost the foreign investment.

The impact of culture and patriotism on investment decisions in equity markets has been well documented (Beugelsdijk and Frijns, 2010; Anderson et al., 2011; Morse and Shive, 2011). However, these results cannot be a priori extended to bond markets that are characterized by a limited participation of individual investors who constitute the investor group that is perceived as being most sensitive to behavioral heuristics (e.g. Chuang and Susmel, 2011). Indeed, as opposed to the studies on equity home bias (Beugelsdijk and Frijns, 2010; Anderson et al., 2011), I do not find any robust evidence of a significant impact of cultural distance on investment decisions in bond markets. Cultural distance does not increase either overinvestment in domestic debt securities or underinvestment in foreign debt securities. One potential explanation may be the lower importance of information asymmetries in debt compared to equity markets. By contrast, patriotism and uncertainty avoidance of the home country play an important role in the explanation of home bias in bonds. Patriotism fosters overinvestment in domestic debt securities and increases underinvestment in foreign debt markets. Societies characterized by higher uncertainty avoidance display a lower preference for foreign debt securities.

The obtained results corroborate the importance of behavioral and cultural effects in the explanation of investment decisions. Patriotism and uncertainty avoidance appear to be asset-invariant determinants of the financial decision making. The perceived mean-variance characteristics of a security are affected by subjective beliefs that, given the persistence of deeply rooted cultural values, cannot be easily changed. Thus, policy measures aimed at increasing liberalization of financial markets may turn out less effective than expected. In this case, legislators and government officials may have to address behavioral and cultural biases that, however, cannot be easily manipulated.

The essays **"Financialization of Agricultural Futures Markets: Evidence from Quantile Regressions"** and **"Impact of Speculation on Precious Metals Futures Markets"** deal with financial activity in commodity futures markets. The role of speculators and index traders in the price bubbles over the 2005-2008 and 2010-2011 periods has been heavily discussed in the existing literature. Several theoretical concepts elaborate on how speculators may influence the price mechanism. Private information may result in a price impact (Gilbert and Pfuderer, 2014). Alternatively, even in the absence of private information, heterogeneous beliefs about publicly available information may induce a price impact in the "differences of opinion" equilibrium (Singleton, 2014; Fische et al., 2014).

The empirical evidence regarding the impact of speculative activity on the price mechanism in commodity markets remains vague. In spite of the controversial empirical evidence, calls for tighter regulation and closer supervision of financial activity in futures markets have become

more urgent (e.g. Masters, 2008). As a consequence, the US Commodity Futures Trading Commission (CFTC) has initiated a public roundtable for the Aggregation and Position Limits Proposals that aim to re-consider and establish limits on speculative positions in 28 physical commodity futures and option contracts (CFTC, 2013). The discussion on the scope of and the exemption from the position limits is not over yet.

The essay **"Financialization of Agricultural Futures Markets: Evidence from Quantile Regressions"** analyzes the relationship between financial activity and returns in twelve agricultural futures markets. To my knowledge, this study is the first to explicitly account for the non-linearity in the Granger-causal relationship between returns and trader positions in commodity futures markets based on quantile regressions. Most existing empirical studies rely on the Granger causality in mean and fail to document any evidence of a significant Granger-causal relationship between financial activity and returns in agricultural futures markets (e.g. Irwin et al., 2009; Brunetti et al., 2011; Irwin, 2013; Grosche, 2014). In addition to traditional Granger causality in mean, I explore the Granger-causal effects from the perspective of conditional quantiles of the return distribution.

Quantile regressions are an important complement to the "Granger causality in mean" approach. The underlying intuition is that the failure to detect any significant Granger causality in mean may be the consequence of non-linearity of the causal relationship in different parts of the distribution of the dependent variable. If the impact of positions on subsequent returns is positive at some quantiles and negative at other quantiles, the positive and negative causal effects may cancel each other out in the least squares estimations such that no Granger causality in mean is detected – as has been shown by Chuang et al. (2009) for the trading volume-return relationship in stock markets. Theoretical research (e.g. Campbell et al., 1993; Llorente et al., 2002) corroborates the idea of non-linearity in the trading activity-return relationship. Non-informational trades that are recognized and corrected by market participants should be associated with negative causality from past changes in net long positions of traders to returns. Positive causality may arise in case of trades that trigger positive feedback trading of other market participants and, thus, result in price effects that persist for a week or longer. Moreover, observing Granger-causal relationships at individual quantiles allows insight as to the part of the distribution in which Granger causality manifests itself: Does it take place during the times of rising or falling prices, i.e. at high or low quantiles of the return distribution?

Three different trader categories that are commonly associated with financial activity in futures markets are considered. Money managers are typically professional speculators who trade either on their own or on their clients' behalf (CFTC, 2009). In general, other reportables are not professional speculators. This trader category includes individual speculative traders, market

makers and firms managing their own assets (Irwin and Sanders, 2012). Index traders cannot be considered as typical speculators who bet on the future direction of price movements and respond to fundamental and/or technical factors that may influence prices (CFTC, 2006). Index investors typically enter futures markets in order to gain a long-side exposure to a broad index of commodities as an asset class (CFTC, 2006).

Quantile regressions reveal that there are significant Granger-causal effects from trader positions to returns that would not have been unveiled while using the traditional "Granger causality in mean" approach: for index traders in the corn market, for money managers in the cocoa, feeder cattle, sugar and SRW wheat markets and for other reportables in coffee and SRW wheat markets. Albeit Granger causality cannot be interpreted as direct evidence of a price impact, my results imply that Granger causality in mean may underestimate the role of speculators and index traders in the information efficiency of agricultural futures markets. Evidence of non-linearity in the relationship between trader positions and returns can be found, but it does not hold for all twelve agricultural futures markets under consideration.

The essay **"Impact of Speculation on Precious Metals Futures Markets"**, co-authored with David Bosch, analyzes long- and short-term effects of speculative activity on the price mechanism in precious metals markets. As opposed to the existing studies on speculation in precious metals markets that focus on *spot* markets (Mutafoglu et al., 2012; Fassas, 2012), this study examines the relationship between speculative activity and *futures* prices based on the standard "Granger causality in mean" approach. Two different trader categories that are commonly associated with speculative activity are considered: non-commercial traders, i.e. traders whose activity is not related to hedging a physical commodity exposure, and money managers, i.e. professional speculators that constitute a subgroup of the non-commercial trader category. The major innovative contribution of this study is the methodology that allows accounting for the simultaneous impact of hedging pressure and speculative activity on futures returns and volatility. Thus, we eliminate the possibility that our results may be contaminated by the omitted variable bias that arises due to a high correlation between positions of hedgers and speculators. This procedure ensures that a significant coefficient estimate on positions of speculators does not simply reflect the significance of hedgers' positions.

When weekly horizons are considered, we do not detect any predictive power of speculative positions for futures returns. Similarly, there is no evidence that speculative activity destabilizes the price formation by inflating conditional return volatilities in the period after 2006. However, prior to June 2006, we find a statistically significant destabilizing effect of positions of non-commercial traders on conditional volatility in gold, silver and palladium futures markets. In

gold and silver markets, the economic significance is rather low, whereas the destabilizing effect manifests itself in the less liquid and smaller palladium futures market.

Long-horizon regressions indicate that net long positions of speculators accumulated over a monthly period have the potential to inflate prices in the four precious metals futures markets. This effect is especially robust for gold and silver. The economic significance of this potentially destabilizing effect is substantially higher in the period after 2006 compared to the 2000-2006 period. However, there is little evidence that speculators have the potential to inflate prices over longer (e.g. quarterly) time horizons.

The essays **"Financialization of Agricultural Futures Markets: Evidence from Quantile Regressions"** and **"Impact of Speculation on Precious Metals Futures Markets"** show that standard Granger causality tests cannot capture all aspects of the relationship between financial activity and returns in commodity futures markets. Significant Granger-causal effects from positions to returns either arise at individual quantiles of the return distribution or manifest themselves only when the effect of cumulated positions is considered. Albeit significant Granger-causal effects from trader positions to subsequent futures returns cannot be interpreted as evidence of a contemporaneous price impact, the fact that trader positions have the potential to forecast futures returns in agricultural and precious metals markets may be useful to regulators in the discussion on the purpose of the position limits for speculators.

The essay **"Information Content of Trading Activity in Precious Metals Futures Markets"** focuses on information efficiency in precious metals futures markets. The objective of the study is to explore whether trading activity has any informational role in predicting returns as suggested by various theoretical frameworks such as the "sequential information arrival" models of Copeland (1976) and Jennings et al. (1980), the rational expectations equilibrium of Schneider (2009), the "demand discovery" model of Gallmeyer et al. (2005) etc. To the best of my knowledge, this study is the first to apply a regime-dependent approach in order to address potential non-linearities and asymmetries in the predictive power of trading volume and open interest in the context of futures markets. In addition, I explore whether the forecasting power of positions of different trader types (speculators and hedgers) and of their sentiment differs across market regimes that are distinguished based on a Markov switching model. The bull markets are characterized by rising prices and a low return volatility, whereas the bear markets are associated with negative mean returns and a high return variability. Importantly, the differentiation between bull and bear markets is an alternative approach to quantile regressions for dealing with non-linearity: Whereas quantile regressions permit only to distinguish between states characterized by positive and negative returns, Markov switching allows incorporating the second moments of the return distribution.

The consideration of different market states allows for the possibility that the direction of Granger causality from trading activity to returns may be asymmetric across bull and bear markets. In this case, the absence of a significant Granger causality in models without regime switching would not rule out the forecasting power of trading activity for returns in bull and bear market regimes. The idea that the dynamic volume-return causality may not be constant over time is deeply rooted in the theoretical research. For instance, the frameworks of Campbell et al. (1993), Wang (1994) and Llorente et al. (2002) suggest that different volume-return dynamics may arise as a consequence of informational and non-informational trades. In addition, the "learning to be overconfident" hypothesis of Gervais and Odean (2001) predicts that investment gains make investors overconfident such that their trades contain a non-informational component. Hence, distinguishing between bull and bear market regimes may capture the differences in the behavior of market participants in different phases of market sentiment: Under the assumption that gains are easier to realize in market periods associated with an upward price trend and a low return volatility, the bull markets are more likely to be dominated by overconfident investors than the bear market states. If overconfidence induces an overestimation of returns, it may result in price changes that are not justified by fundamentals and prices revert back to their fundamental values on the next day. During the bear markets, i.e. periods of falling prices with a high return volatility, when it is more difficult to make profits, overconfidence is less likely to arise. As a consequence, investors may be less prone to the overestimation of the precision of their information such that informational trades prevail in the bear markets. If private information is not immediately absorbed by the market, we should expect price continuations following increases in trading activity in bear market states.

Empirical results confirm the main hypothesis that the dynamic relationship between trading activity and subsequent returns is asymmetric across bull and bear markets. The analysis also shows that models without regime switching may underestimate the predictability of returns by trading activity. A model without regime switching detects significant Granger-causal effects from trading volume (open interest) to returns only in the silver (platinum) market. Differentiating between different regimes unearths additional forecasting power of trading volume in bull and bear markets for gold and platinum and significant Granger-causal effects from past changes in open interest to returns in all but the palladium bear market. These results are robust to different rollover procedures and regression specifications.

Silver is the only market where the direction of the volume-return causality is constant across the two market states. By contrast, an asymmetric (or non-linear) direction of the dynamic volume-return relation can be observed for gold, platinum and palladium: The direction of Granger causality from trading volume to returns is negative in bull and predominantly positive

in bear markets. The same pattern can be observed for the open interest-return dynamics in platinum and palladium markets. Both the sign of the serial return correlation and the direction of the trading activity-return relation allow differentiating between informational and non-informational buying and selling pressure. With the exception of silver bear and palladium bull markets, there is strong evidence that non-informational trades prevail in bull markets, whereas bear markets are dominated by trades that are based on private information.

The documented asymmetric relationship between trading activity and returns has important implications for investment and hedging strategies. There is solid evidence of the information content of both trading volume and open interest that forecast returns not only in the less liquid markets such as palladium, but also in highly liquid gold and silver futures markets. However, investment strategies that seek to profit from return predictability by trading activity should account for the fact that the direction of the dynamic trading activity-return causality may differ across different market states and that it may manifest itself only in one market state. Moreover, market participants who are closely watching the trading activity in futures markets should be aware of the fact that the direction of Granger-causal effects from trading activity to returns may depend on the proxy used to measure the trading activity, i.e. trading volume or open interest.

References

Anderson, C.W., Fedenia, M., Hirschey, M., Skiba, H. (2011). Cultural influences on home bias and international diversification by institutional investors. Journal of Banking and Finance, 35, 916-934.

Beugelsdijk, S., Frijns, B. (2010). A cultural explanation of the foreign bias in international asset allocation. Journal of Banking and Finance, 34, 2121–2131.

Brunetti, C., Buyuksahin, B., Harris, J.H. (2011). Speculators, prices and market volatility. SSRN Working Paper. Accessed July 2015, available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1736737.

Campbell, J.Y., Grossman, S.J., Wang, J. (1993). Trading volume and serial correlation in stock returns. The Quarterly Journal of Economics, 108, 905–939.

Chuang, C-C., Kuan, C-M., Lin, H-Y. (2009). Causality in quantiles and dynamic stock return-volume relations. Journal of Banking and Finance, 33, 1351-1360.

Chuang, W.-I., Lee, B.-S. (2006). An empirical evaluation of the overconfidence hypothesis. Journal of Banking and Finance, Vol. 30, 2489-2515.

Chuang, W.-I., Susmel, R. (2011). Who is the more confident trader? Individual vs. institutional investors. Journal of Banking and Finance, 35, 1626-1644.

Chui, A., Titman, S., Wei, J. (2010). Individualism and momentum around the world. Journal of Finance, 45, 361-392.

CFTC (2006). Commission actions in response to the Comprehensive review of the Commitments of Traders reporting program. Accessed July 2015, available at: http://www.cftc.gov/files/cftc/cftcnoticeonsupplementalcotreport.pdf.

CFTC (2009). Disaggregated commitments of trader reports: Explanatory notes. Accessed July 2015, available at: http://www.cftc.gov/MarketReports/CommitmentsofTraders/DisaggregatedExplanatoryNotes/index.htm.

CFTC (2013). Position limits for derivatives. Federal Register 78. Accessed July 2015, available at: http://www.cftc.gov/ucm/groups/public/@lrfederalregister/documents/file/2013-27200a.pdf.

Copeland, T.E. (1976). A model of asset trading under the assumption of sequential information arrival. Journal of Finance, 31, 1149-1168.

Fassas, A. (2012). Exchange-traded products investing and precious metals prices. Journal of Derivatives and Hedge Funds, 18, 127-140.

Ferreira, M.A., Miguel, A.F. (2011). The determinants of domestic and foreign bond bias. Journal of Multinational Financial Management, 21, 279-300.

Fidora, M., Fratzscher, M., Thimann, C. (2007). Home bias in global bond and equity markets: the role of real exchange rate volatility. Journal of International Money and Finance, 26, 631-655.

Fische, R.P.H., Janzen, J.P., Smith, A. (2014). Hedging and speculative trading in agricultural futures markets. American Journal of Agricultural Economics, 96, 542-556.

Gallmeyer, M., Hollifield, B., Seppi, D.J. (2005). Demand discovery and asset pricing. Working paper. Accessed July 2015, available at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.139.7016&rep=rep1&type=pdf.

Gervais, S., Odean, T. (2001). Learning to be overconfident. Review of Financial Studies, 14, 1-27.

Giannetti, M., Koskinen, Y. (2010). Investor protection, equity returns, and financial globalization. Journal of Financial and Quantative Analysis, 45, 135-168.

Gilbert, C.L., Pfuderer, S. (2014). The role of index trading in the price formation in the grains and oilseeds markets. Journal of Agricultural Economics, 65, 303-322.

Giofré, M. (2013). Investor protection rights and foreign investment. Journal of Comparative Economics, 41, 506-526.

Giofré, M. (2014a). Domestic investor protection and foreign portfolio investment. Journal of Banking and Finance, 46, 355-371.

Giofré, M. (2014b). Comparative corporate governance and international portfolios. European Journal of Finance, forthcoming.

Gilbert, C.L., Pfuderer, S. (2014). The role of index trading in the price formation in the grains and oilseeds markets. Journal of Agricultural Economics, 65, 303-322.

Grosche, S. (2014). What does Granger causality prove? A critical examination of the interpretation of Granger causality results on price effects of index trading in the agricultural commodity markets. Journal of Agricultural Economics, 65, 279-302.

Hofstede, G., Hofstede, G.J., Minkov, M. (2010). Cultures and organizations: software of the mind, 3rd edn, New York: McGraw-Hill USA.

House, R.J., Hanges, P.J., Javidan, M., Dorfman, P.W., Gupta, V. (2004). Culture, leadership, and organizations: the GLOBE study of 62 societies. Sage Publications, Thousand Oaks, CA.

Irwin, S.H., Sanders, D.R., Merrin, R.P. (2009). Devil or angel? The role of speculation in the recent commodity price boom (and bust). Journal of Agricultural and Applied Economics, 41, 377-391.

Irwin, S.H., Sanders, D.R (2012). Testing the Masters hypothesis in commodity futures markets. Energy Economics, 34, 256-269.

Irwin, S.H. (2013). Commodity index investment and food prices: does the "Masters Hypothesis" explain recent price spikes? Agricultural Economics, 44, 29-41.

Jennings, R.H., Starks, L.T., & Fellingham, J.C. (1981). An equilibrium model of asset trading with sequential information arrival. Journal of Finance, 36, 143-161.

Llorente, G., Michaely, R., Saar, G., Wang, J. (2002). Dynamic volume-return relation of individual stocks. The Review of Financial Studies, 15, 1005-1047.

Masters, M.W. (2008). Testimony before the Committee on Homeland Security and Governmental Affairs. United States Senate, May 20. Accessed July 2015, available at: http://hsgac.senate.gov/public/_files/052008Masters.pdf.

Morse, A., Shive, S. (2011). Patriotism in your portfolio. Journal of Financial Markets, 14, 411-440.

Mutafoglu, T.K., Tokat, E., Tokat, H. A. (2012). Forecasting precious metal price movements using trader positions. Resources Policy, 37, 273-280.

Schneider, J. (2009). A rational expectations equilibrium with informative trading volume. Journal of Finance, 64, 2783-2805.

Singleton, K.J. (2014). Investor flows and the 2008 boom/bust in oil prices. Management Science, 60, 300-318.

Wang, J. (1994). A model of competitive stock trading volume. Journal of Political Economy, 102, 127–168.

Impact of Domestic Creditor Protection on Foreign Bond Bias

Elina Pradkhan

Humboldt University of Berlin
Institute of Finance
elina.pradkhan@hu-berlin.de

Abstract

This study contributes to the existing literature on home bias by exploring the relationship between domestic creditor protection and foreign investment decisions in bond markets. It also investigates how the difference between domestic and foreign creditor protections affects the foreign investment. The impact of domestic creditor protection on cross-border investment in bonds is twofold. A high level of domestic creditor protection increases international diversification. At the same time, an efficient protection of creditor rights at home reduces the sensitivity of foreign investment to foreign creditor protection. These results hold most strongly for investing countries with high levels of domestic creditor protection. In addition, this study shows that the difference between domestic and foreign creditor protections matters for investment decisions: If domestic creditor protection is more efficient than foreign creditor protection, the sensitivity of foreign investment to foreign (domestic) creditor protection decreases (increases).

JEL Classification: G02, G11, G15, G30

Keywords: home bias, international diversification, creditor protection, bonds.

1 Introduction

Under the assumption of perfectly efficient capital markets, all investors should hold the same value-weighted portfolio where the weight of each asset corresponds to its weight in the world market portfolio, independently of the nationality and relative risk aversion of individual investors (Sercu, 1980). However, if diversification costs exceed diversification benefits, home bias arises: Investors assign disproportionately high shares of their portfolios to domestic assets and underweight foreign assets (Lewis, 1999). Existing literature distinguishes two aspects of the home bias phenomenon: the domestic bias (overinvestment in domestic bonds) and the foreign bias (bilateral over- or underinvestment in bonds issued in different destination countries). Inefficient protection of investor rights may become an important barrier to foreign investment if the level of investor protection is not fully incorporated in asset prices.[1]

Whereas the existing studies on foreign bond bias explore the importance of investor protection in destination countries (Fidora et al., 2007; Ferreira and Miguel, 2009; Giofré, 2013), the focus of this study is the way in which domestic creditor protection impacts foreign investment decisions in debt markets. This paper is closely linked to the evidence of Giofré (2014a) who shows that domestic corporate governance exerts a twofold effect on cross-border investment in equity markets. A high level of domestic investor protection does not only directly increase the bilateral equity investment, but also indirectly impacts the foreign equity bias in the sense that a high shareholder protection at home reduces the investors' responsiveness to the shareholder protection in destination countries (Giofré, 2014a).

The interaction effects between domestic and foreign investor protections have received comparatively little attention in the existing research. The "good country bias" theory of Giannetti and Koskinen (2010) implies that portfolio investors from countries with weak shareholder protection invest more in foreign stocks than portfolio investors from countries with a more efficient protection of their rights. The "comparative corporate governance" theory of Giofré (2014b) is based on the assumption that the driver of cross-border investment decisions in equity markets is the foreign relative to the domestic investor protection.

The results for equity markets cannot trivially be extended to bond markets. Information costs faced by foreign investors are closely related to investor protection and legal environment (Gehrig, 1993; Leuz et al., 2009). Given that information asymmetries are less relevant for the

[1] Given the investor heterogeneity (e.g. foreign versus domestic investors as well as familiarity-biased versus rational market participants), equilibrium asset prices do not necessarily fully reflect the level of investor protection (Giannetti and Koskinen, 2010; Leuz et al., 2009; Cao et al., 2009). If the discount for bonds issued in countries that offer only a poor protection of creditor rights is not sufficient to compensate the bondholders, laws protecting the rights of bondholders and the confidence in the efficient and impartial enforcement of these laws may impact investment decisions.

payoff of a fixed claim compared to a residual claim,[2] domestic investor protection may not impact the cross-border investment in bonds in the same way as the cross-border investment in equities.[3]

This study makes two contributions to the existing literature. First, it examines whether the twofold effect of domestic investor protection, as documented by Giofré (2014a) for equity markets, is an asset-invariant phenomenon, i.e. whether it also holds in bond markets. Second, this study investigates how the difference between domestic and foreign creditor protections affects the foreign investment's sensitivity to domestic and foreign creditor protection levels. In this respect, it is an extension of the "good corporate governance theory" of Giannetti and Koskinen (2010) and the "comparative corporate governance theory" of Giofré (2014b) that focus only on the direct effect of the difference between domestic and foreign investor protections on foreign investment.

An analysis of cross-border debt holdings of 36 countries over the 2004-2012 period reveals that the twofold effect of domestic investor protection that has been documented for equity markets seems to hold in bond markets as well. A high level of domestic creditor protection increases foreign investment, but decreases the foreign investment's sensitivity to the creditor protection in destination countries. These results are valid not only for traditional measures for the protection of the secured creditors' rights by collateral and bankruptcy laws, but also with regard to the quality of legal environment, in particular the efficiency and impartiality of the judicial system.

However, this study also documents important differences between investing countries with creditor protections above and below the world average. The twofold effect of domestic creditor protection on international diversification manifests itself for the total sample and for investors from countries with relatively high levels of creditor protection. By contrast, the results are different for investors from countries with creditor protection below the world average. In this case, a high level of domestic creditor protection is associated with a lower level of the foreign bond bias, i.e. investors from countries where their rights are well protected are less likely to diversify their portfolios abroad, and the investors' sensitivity to the foreign creditor protection is not significantly affected by the level of creditor protection at home.

[2] In this respect, Portes et al. (2001) show that the impact of information asymmetries on the US residents' foreign transactions is higher for equities than for bonds.

[3] Existing literature documents that there are substantial differences in the impact of the protection of investor rights in destination countries on the cross-border investment in equities and bonds: De Moor and Vanpée (2013) and Giofré (2013) show that the level of investor protection in destination countries is less important for cross-border investment in bonds compared to equities.

With respect to the "good country bias" and "comparative corporate governance" theories, the empirical evidence finds little support for these concepts in the context of the cross-border investment decisions in bond markets. However, this study shows that the difference between domestic and foreign creditor protections affects the foreign investment indirectly via the sensitivity of foreign investment to creditor protections in home and host countries. A higher domestic creditor protection relative to the creditor protection in the destination country reduces (increases) the sensitivity of foreign investment to foreign (domestic) creditor protection. This evidence strengthens the importance of domestic creditor protection in the foreign debt portfolio choices. It appears to be more than a simple benchmark against which the protection of creditor rights abroad is evaluated.

This paper is structured as follows. Section 2 briefly summarizes the existing literature on home bias and creditor protection. In Section 3, data and methodology are outlined. Section 4 presents the empirical results. Section 5 concludes.

2 Related Literature

The importance of investor protection for portfolio allocation decisions has attracted considerable attention in the empirical and theoretical research. Several studies confirm both empirically and theoretically the importance of corporate governance of the home (host) country as an explanation of domestic (foreign) bias in equity markets (e.g. Dahlquist et al., 2003; Giannetti and Simonov, 2006; Kho et al., 2009). In equity markets, two types of investors are distinguished: portfolio investors whose returns from the share ownership consist solely of dividends and capital gains/losses and controlling shareholders who draw an additional advantage from their shares, namely the private benefits from control (Dahlquist et al., 2003). This differentiation is closely related to the efficiency of corporate governance mechanisms that protect portfolio investors from expropriation by managers and controlling shareholders.

In the framework of Dahlquist et al. (2003), international diversification in equity portfolios is impeded by the increasing demand of controlling shareholders who are not willing to sell their closely held shares at the prevailing market price. Controlling shareholders demand a control premium that portfolio investors are not willing to pay (Dahlquist et al., 2003). In the framework of Giannetti and Koskinen (2010), stock prices in countries with a low degree of investor protection do not fully reflect losses that accrue to portfolio investors as a consequence of the rising demand of controlling shareholders.[4] According to Giannetti and Koskinen (2010),

[4] Given that the market price is determined by the demand of both the controlling and portfolio shareholders, the demand of controlling shareholders drives up the price above the value that would prevail in the absence of controlling shareholders and that is needed to compensate portfolio shareholders for the extraction of private benefits by corporate insiders (Giannetti and Koskinen, 2010).

portfolio investors exhibit the so called good country bias: They invest more in a host country that offers more efficient corporate governance mechanisms than their home country.

Compared to home bias in equities, the importance of investor protection for home bias in bonds has received less attention. Moreover, the existing empirical evidence on the impact of creditor protection on home bias in bonds is controversial. Ferreira and Miguel (2011) show that, whereas domestic bias in bonds, i.e. the overinvestment in domestic bonds, is negatively related to the efficiency of the domestic judicial system, neither the efficiency of the judicial system nor the common law legal origin of destination countries have any robust impact on the foreign bond bias, i.e. international diversification in bond portfolios. Fidora et al. (2007) document that the cross-border investment in bonds is more sensitive to institutional and political variables of the destination country, e.g. investment and political risk, the efficiency of the judicial system, corruption and the quality of information disclosure, than the cross-border investment in equities. De Moor and Vanpée (2013) show that corporate governance both on the country and corporate level[5] matters only for home bias in equities, but not for home bias in bonds. Giofré (2013) examines the impact of creditor and shareholder protection of host countries on home bias in bond and equity portfolios over the 2001-2006 period. The impact of the protection of both creditor and shareholder rights on the international investment in equity securities is positive. By contrast, host countries characterized by a strong protection of shareholder rights are less attractive for bondholders, whereas the positive impact of creditor rights on foreign bond investment manifests itself only in conjunction with the efficiency of the judicial system (Giofré, 2013).

The study that is most closely related to the subject of this paper is that of Giofré (2014a) who examines the role played by domestic corporate governance mechanisms in the cross-country allocation decisions in equity markets. In addition to a positive impact of shareholder protection in both host and home countries on international diversification in equity portfolios, Giofré (2014a) documents a negative interaction effect between the corporate governance practices of home and host countries on home bias in equities. In particular, she shows that the foreign portfolio composition is indirectly affected by domestic corporate governance: Shareholder protection at home influences the investors' responsiveness to the shareholder protection in foreign countries. This evidence is interpreted in favor of decreasing marginal returns on corporate governance: An efficient domestic protection of shareholder rights contributes substantially to the optimal corporate governance level such that less attention is paid to the investor protection in destination countries (Giofré, 2014a). Furthermore, Giofré (2014b) shows

[5] The government effectiveness indicator of the World Bank is used as a proxy for country level governance, whereas corporate governance is approximated by the corporate board efficacy indicator of the Global Competitiveness Report (De Moor and Vanpée, 2013).

that it is not the foreign shareholder protection scaled by the world average corporate governance, but the foreign shareholder protection relative to the domestic corporate governance that determines the foreign equity allocation decisions.

This study complements the existing literature on the relationship between creditor protection and foreign bias in bonds in several ways. First, it examines the role of domestic creditor protection in the foreign investment decisions in bond markets. The focus lies on the role of the domestic protection of creditor rights in allocation decisions regarding foreign bonds and on whether the twofold effect of domestic investor protection, as documented by Giofré (2014a) for equity markets, applies uniformly to all debt markets. For this purpose, I consider a broad sample of developed and developing investing countries both during the crisis and more tranquil times and a variety of internationally recognized measures for the protection of creditor rights. Second, this study explores the "good country bias" theory of Giannetti and Koskinen (2010) and the "comparative corporate governance theory" of Giofré (2014b) in the context of the home bias in bonds. Finally, it investigates whether the difference between the levels of creditor protection in domestic and destination countries affects the sensitivity of foreign investment to domestic and foreign creditor protections.

3 Data and Methodology

3.1 Data

3.1.1 Foreign Bond Bias

The analysis encompasses the annual cross-border investment of major developed and developing countries (22 developed and 15 developing countries as shown in Table 1) during the 2004-2012 period. Given that portfolio allocation to bonds issued in a country j depends on the market capitalization of these bonds relative to the world bond market capitalization, the cross-border investment is examined in the context of the foreign bias. Foreign bias is a widely used measure of international diversification that captures the relative under- or overweighting of foreign assets relative to the optimal benchmark, i.e. the foreign bond bias reflects the difference between the actual fraction of the country i's total debt portfolio allocated to debt securities issued by residents of a host country j ($w_{i,j}$) and the weight of the country j' debt securities in the world debt market portfolio (w_j^*). Following the existing literature (e.g. Chan et al., 2005), the foreign bias $FBIAS_{i,j}$ of investors domiciled in country i towards debt securities issued by residents of a host country j is computed as:

$$FBIAS_{i,j} = \ln(w_{i,j}) - \ln(w_j^*) \quad (1).$$

$FBIAS_{i,j}$ takes negative values in case of underinvestment, whereas overinvestment in bonds issued in the host country j results in a positive $FBIAS_{i,j}$. The higher the foreign bias $FBIAS_{i,j}$ is, the more residents of the country i allocate to bonds issued by residents of the country j. In the following, the terms foreign bias, international diversification and cross-border investment will be used interchangeably. Table 1 reports the equally weighted average foreign bias levels that investors in country i display towards sample host countries.

The data on bond market capitalizations provided by the Debt Securities Statistics of the Bank for International Settlements (BIS) are used to derive the optimal portfolio weights w_j^*. The data on the bilateral and total foreign investment are drawn from the Coordinated Portfolio Investment Survey (CPIS) of the International Monetary Fund (IMF). The computation of the actual portfolio weights $w_{i,j}$ requires information on the total debt portfolio of the investing country i that, however, is not reported. In order to derive the total value of investment in domestic bonds, I adopt the procedure of Fidora et al. (2007) who approximate domestic debt holdings by the difference between the home country i's debt market capitalization and the sum of portfolio holdings of the home country i's debt securities by reporting countries. Then, the total debt portfolio is calculated as the sum of the derived domestic debt holdings and the total value of foreign debt investment as reported by the CPIS.

Despite the fact that the CPIS provides the most comprehensive and widely used dataset on cross-country portfolio holdings, there are several disadvantages associated with the CPIS data. First, the CPIS compilers face difficulties in determining the country of residence of non-resident issuers of securities held by their residents (IMF, 2002). Second, as far as the valuation of positions is concerned, if reporting takes place on an aggregate basis, the CPIS compilers cannot verify whether the reported securities have been evaluated correctly (IMF, 2002). Moreover, Lane and Milesi-Ferretti (2004) criticize the lack of data on some large portfolio holders such as Taiwan, Saudi Arabia and the United Arab Emirates. An additional major drawback of the applied methodology is the valuation method. Whereas the CPIS data on foreign holdings are valued at current market prices or as the net present value of the expected cash flows, the Total Debt Securities data of the BIS are derived based on nominal values for a variety of countries such as Austria, Germany, Belgium etc.

3.1.2 Creditor Protection

The creditor rights index of Djankov et al. (2007) is used as the main proxy for the efficiency of creditor rights protection. It ranges from zero to four with higher scores corresponding to a higher protection of secured creditors. The index has been compiled based on an analysis of bankruptcy-related laws and a survey of local bankruptcy lawyers (Djankov et al., 2007). It

aggregates four rights of secured lenders: whether filing for reorganization is contingent on creditor consent, whether the collateral accrues to secured creditors once the petition for reorganization has been approved, whether claims of secured creditors are given priority in case of liquidation and whether the responsibility for running the debtor's business lies with an administrator instead of management (Djankov et al., 2007). Annual data are available over the 1978-2003 period. Since the sample ranges from 2004 to 2012, the creditor rights index as of 2003 is used in all estimations.

In order to ensure that the creditor rights index as of 2003 reflects the actual level of creditor protection over the 2004-2012 sample period, I review the recent laws and jurisdiction changes that took place in the last decade. The World Bank's *Doing Business* report provides an overview of the relevant reforms for most sample countries.[6] As a next step, the reforms are scrutinized under the aspect whether the four rights of secured creditors as defined by Djankov et al. (2007) have been affected. Surprisingly, none of the laws has resulted in an improvement of the secured creditor rights protection of Djankov et al. (2007) during the sample period. One potential explanation may be that the most recent amendments and reforms of bankruptcy laws have been aiming at facilitating business recoveries, whereas the going concern option is often either of no use to or not in the interest of the secured creditors.

Although the creditor rights index indicates that laws and legislations that protect the rights of secured bondholders exist, it does not provide any insight as to whether the enforcement of these laws is efficient. The wedge between the existence of laws protecting creditor rights and the efficient enforcement of these laws may be crucial for investment decisions. For instance, Miller and Puthenpurackal (2002) find that the premium that investors demand for public debt issues of non-US firms in the Yankee bond market depends both on the existence of laws protecting the creditor rights and the enforcement of these laws. Boubakri and Ghouma (2010) show that it is the enforcement of creditor rights and not the existence of laws that protect creditor rights that determines the corporate bond yield spreads and ratings.

Therefore, variables that account for the efficiency of legal system are included in all regression specifications. The rule of law index is a time-varying indicator that is drawn from the World Governance Indicators (WGI) of the World Bank. Inter alia, it reflects the quality of contract enforcement as well as efficiency and impartiality of courts (Kaufmann et al., 2010). As an alternative to the rule of law index, I use the integrity of legal system from the Economic Freedom of the World (EFW) 2014 dataset. It provides a time-varying assessment of the efficiency of legal system over the 2004-2012 period. It is based on the political risk component

[6] More information can be found at: http://www.doingbusiness.org/reforms/overview/topic/resolving-insolvency.

for law and order of the International Country Risk Guide and assesses the strength and impartiality of the legal system as well as the popular observance of law (EFW, 2013).

Alternative measures of the protection of creditor rights are also used. The time-varying strength of legal rights index is drawn from the World Bank's World Development Indicators (WDI). It assesses whether collateral laws protect the rights of borrowers and lenders and whether bankruptcy laws safeguard the rights of secured creditors. It aggregates various aspects of legal rights in collateral and bankruptcy laws, of which the majority is related to collateral laws. As far as the rights of secured creditors are concerned, it is assessed whether the claims of secured creditors are given priority in case of liquidation (or when the default takes place outside an insolvency procedure) and whether the secured creditors' claims are exempt from an automatic stay or moratorium on enforcement procedures in case of reorganization.[7] Thus, only two aspects of the creditor rights index of Djankov et al. (2007) are reflected in the strength of legal rights index of the World Bank: the priority of the secured creditors' claims in case of liquidation and the ability to seize the collateral after the approval of a reorganization petition. The index is available for all sample years from 2004 to 2012.

An additional proxy for the protection of creditor rights is the efficiency of debt enforcement procedures of Djankov et al. (2008) derived based a survey of bankruptcy practitioners faced with a case study regarding an insolvent firm as of January 2006. The efficiency E is defined as the value preserved in debt enforcement proceedings and is computed as the terminal value of the firm discounted by the nominal lending rate r (Djankov et al., 2008):

$$E = \frac{100*GC+70*(1-GC)-100*c}{(1+r)^t} \quad (2).$$

The terminal value is determined by whether the firm chooses the going concern option that is assumed to be the most efficient basic procedure: GC is the dummy variable that takes the value of one if the insolvent firm continues as going concern, and zero otherwise. Bankruptcy costs c and the time needed to resolve insolvency t diminish the terminal value (Djankov et al., 2008). 100 is the firm value as going concern, whereas liquidation yields a lower terminal value of 70. Importantly, a high terminal value may benefit predominantly shareholders and junior bondholders, whereas a senior bondholder may be better off with liquidation that typically results in lower terminal values.

As opposed to the time-invariant efficiency of debt enforcement procedures of Djankov et al. (2008), the recovery rate of the World Bank's *Doing Business* report may be a more appropriate

[7] See http://www.doingbusiness.org/methodology/getting-credit for more detailed information on the definition and computation of the strength of legal rights index.

measure for the efficiency of debt enforcement procedures. It is available for individual years during the entire sample period. As the efficiency of debt enforcement procedures of Djankov et al. (2008), the recovery rate represents cents per dollar obtained by secured creditors as a consequence of reorganization, liquidation or debt enforcement proceedings.[8] Both measures for the economic efficiency of debt enforcement proceedings are highly correlated (Table 2).

Table 2 shows the correlations between different proxies for the creditor rights protection (the creditor rights index of Djankov et al. (2007), the efficiency of debt enforcement of Djankov et al. (2008), the recovery rate of the World Bank's *Doing Business*, the legal rights index of the World Bank) and the quality of law enforcement (the rule of law index of the World Bank and the integrity of legal system of the EFW) with each other and their correlations with some of the country-specific economic and financial characteristics that are used as control variables. All proxies for creditor protection are positively correlated. As the creditor rights index of Djankov et al. (2007) displays the lowest correlation with control variables, it is used as the main proxy for creditor protection in order to contain collinearity problems.

La Porta et al. (1998) argue that creditor rights are more complex than shareholder rights, inter alia due to the heterogeneity within the bondholders as a group. An important limitation of our analysis is the derivation of the foreign bias based on the CPIS data on total debt. The derivation of the dependent variable does not allow differentiating between corporate and sovereign debt as well as senior and junior bondholders. Senior and junior bondholders may have conflicting interests. For instance, senior creditors may prefer liquidation that guarantees a repayment of their claims, whereas junior bondholders may opt for the less certain going concern solution if they do not receive their claims in case of an immediate liquidation of a firm's assets. Several proxies for the strength of creditor protection (the creditor rights index and the strength of legal rights index) are derived from the perspective of senior lenders who have secured claims vis-à-vis corporations.

Furthermore, creditor control, monitoring and enforcement are much more complex in sovereign debt markets compared to markets for corporate debt. There are no formal bankruptcy procedures for sovereign debt and typical creditor rights such as access to management and seizing secured assets cannot be easily enforced vis-à-vis a sovereign (Yadav, 2014). Although it is commonly assumed that sovereign creditors have little or no legal recourse, non-legal mechanisms such as a damaged reputation and legal terms that can be enforced by courts[9]

[8] See http://www.doingbusiness.org/Methodology/resolving-insolvency#creditorScore for more details.

[9] Examples for these legal terms are enforcement clauses (e.g. waivers of sovereign immunity) and restructuring clauses (e.g. collective action clauses). This is, however, not the case for sovereign debt with contracts governed under the local law that can be easily modified at a sovereign's discretion. By

protect the rights of creditors in countries affected by a high default risk (Choi et al., 2012). Thus, in spite of the strong heterogeneity within the examined group of bondholders, the proxies for the quality of the law enforcement (rule of law and integrity of legal system) may still be useful indicators for the protection of investor rights in sovereign and junior debt markets even if the effect of proxies for the protection of secured creditors rights, e.g. the creditor rights index of Djankov et al. (2007), on the aggregate cross-border investment may be less prominent.

Table 3 shows the correlations of different proxies for the protection of secured creditors and the quality of law enforcement with annual foreign bias levels of sample countries during the 2004-2012 period. As expected, the proxies for the efficiency and quality of law enforcement display higher correlations with foreign bias than the proxies for the protection of the secured creditors' rights. Importantly, the correlation between foreign bias and domestic creditor protection is considerably higher than the correlation between foreign bias and creditor protection in destination countries.

3.2 Methodology

Direct and Indirect Effects of Domestic Creditor Protection

Following Giofré (2014a), the foreign bias $FBIAS_{i,j}$ that investors from country i display towards debt securities issued by residents in a destination country j is specified as:[10]

$$FBIAS_{i,j} = f(CV_i, CV_j, CV_{i,j}, \boldsymbol{CR_i}, \boldsymbol{CR_j}, \boldsymbol{CR_i * CR_j}) \quad (3).$$

Foreign bias is a function of control variables that capture home and host country-specific characteristics, CV_i and CV_j, control variables that reflect bilateral effects, $CV_{i,j}$, and the variables of interest: creditor protections in home and host countries, CR_i and CR_j, and their interaction term, $CR_i * CR_j$. As home and host country-specific effects, CV_i and CV_j, I include the bank size,[11] capital account liberalization of the EFW, GDP per capita growth rate drawn from the World Bank's WDI, sovereign stability, bond market development, rule of law and depth of credit information indices of the World Bank's WGI and WDI and a dummy variable that takes the value of one in case of a developed host or home country.[12] Bilateral effects $CV_{i,j}$

---

contrast, creditors who purchase sovereign debt governed under foreign law (typically New York or English law) enjoy a higher protection (Choi et al., 2011).

[10] For the sake of simplicity, time subscripts for the dependent and time-varying explanatory variables are omitted in all regression specifications.

[11] Bank size is proxied by the ratio of deposit assets to GDP as reported by the Global Financial Development Database of the World Bank. Since data are not available for several sample countries (e.g. Canada, Chile, Czech Republic, Norway, Hungary) and do not cover the year 2012, this control variable is included only in one regression specification (column (3) of Table 4).

[12] Fitch local currency sovereign credit ratings are converted to numerical values with higher numbers reflecting a higher degree of sovereign stability. Positive and negative credit outlooks are also accounted

are closely related to information asymmetries and familiarity: geographical distance, bond market return correlation and dummy variables that account for common border, legal origin, colonial past, language and regional membership in the EMU, NAFTA, MERCOSUR, ASEAN.[13]

Importantly, the foreign bias $FBIAS_{i,j}$ is determined by the domestic bias $DBIAS_i$ (i.e. the overinvestment in domestic bonds) in the sense that the higher the fraction of domestic bonds in the portfolio is, the less can be allocated to foreign bonds (Beugelsdijk and Frijns, 2010; Anderson et al., 2011). Given that domestic creditor protection CR_i is an important determinant of $DBIAS_i$ (e.g. Ferreira and Miguel, 2010), CR_i may be found to be significant in Eq. (3) simply due to its correlation with $DBIAS_i$. In order to ensure that its impact on $FBIAS_{i,j}$ does not arise as a consequence of the omitted variable bias, Eq. (4) substitutes the control variables related to home country-specific characteristics by the domestic bias $DBIAS_i$:

$$FBIAS_{i,j} = f(DBIAS_i, CV_j, CV_{i,j}, \boldsymbol{CR_i}, \boldsymbol{CR_j}, \boldsymbol{CR_i} * \boldsymbol{CR_j}) \quad (4).$$

Home country-specific characteristics CV_i are omitted in Eq. (4) to avoid collinearity problems given that control variables that account for home country-specific characteristics also impact the overinvestment in domestic bonds. Domestic bias is computed as:

$$DBIAS_i = \ln(w_i) - \ln(w_i^*) \quad (5),$$

where w_i is the actual debt portfolio weight allocated to domestic debt securities by investors from country i and w_i^* represents the weight of domestic bonds in the world debt market capitalization. Table 1 reports domestic bias levels of the sample countries.

The main estimation technique is the ordinary least squares (OLS) with robust standard errors and time dummies that account for time effects. One disadvantage of the OLS estimation with time-fixed effects is the neglected cross-sectional information. In order to account for both time-series and cross-sectional information, I also use the feasible generalized least squares (FGLS) estimator for panel data under the assumption of a heteroskedastic error structure with no cross-sectional correlation.

---

for. Bond market development is approximated by the ratio of international debt to the total international debt outstanding (Source: BIS).

[13] Geographical distance is computed as natural logarithm of the distance in kilometers between the capitals of host and home countries. Correlations are computed based on the JP Morgan GBI 1-10 years total return indices denominated in USD on a monthly basis over the 2000-2013 period. For Norway, BofA Merrill Lynch 1-10 years total return index is used. The data on geographical distance, common border, language and colonial past are drawn from the CEPII.

The focus of this study is to identify the impact of domestic creditor protection on foreign investment decisions. Following Giofré (2014a), direct and indirect effects are distinguished. In the following, the coefficient estimates on CR_i, CR_j and $CR_i * CR_j$ will be denoted as δ^{CR_home}, δ^{CR_host} and δ^{int}, respectively. δ^{CR_home} reflects the direct effect of domestic creditor protection CR_i on the investment in bonds issued by residents in the host country j. The sign of δ^{CR_home} is a priori unclear. $\delta^{CR\_home} < 0$ would imply that investors from countries with poor protection of their rights diversify their bond portfolios internationally where they are more likely to benefit from a higher level of creditor protection. This would be in line with the "good country bias" theory of Giannetti and Koskinen (2010). By contrast, $\delta^{CR\_home} > 0$ would be consistent with the evidence of Giofré (2014a) that investors who benefit from a high level of protection at home invest more in foreign securities.

Whereas δ^{CR_home} denotes the direct effect of domestic creditor protection CR_i on $FBIAS_{i,j}$, δ^{int} measures the indirect effect of domestic creditor protection on foreign investment: Creditor protection at home influences the international diversification $FBIAS_{i,j}$ by affecting the sensitivity of domestic investors to the foreign creditor protection CR_j (Giofré, 2014a). The responsiveness of the domestic investors' holdings of the host country j's bonds to the level of creditor protection in this host country is given as:

$$\frac{\partial FBIAS_{i,j}}{\partial CR_j} = \delta^{CR\_host} + \delta^{int} * CR_i \qquad (6).$$

If investors from countries with more efficient protection of creditor rights ($CR_i \uparrow$) are more tolerant towards or pay little attention to the degree of creditor protection abroad, a negative δ^{int} is expected, whereas a positive coefficient δ^{int} would imply that a high level of creditor protection at home ($CR_i \uparrow$) makes investors more demanding with respect to the creditor protection in foreign countries (Giofré, 2014a).

Is domestic creditor protection only a benchmark against which the foreign creditor protection is evaluated?

The "good country bias" theory of Giannetti and Koskinen (2010) suggests that the difference between domestic and foreign investor protections matters for portfolio allocation decisions. Giofré (2014b) elaborates this idea by showing that domestic shareholder protection serves as a benchmark against which the foreign investor protection is evaluated. I test whether the results of Giannetti and Koskinen (2010) and Giofré (2014b) are also valid in bond markets. The following regression specifications are used in order to examine whether the role of domestic creditor protection is restricted merely to a benchmark against which the foreign creditor protection is evaluated:

$$FBIAS_{i,j} = f\left(CV_i, CV_j, CV_{i,j}, \boldsymbol{CR_j - CR_i}\right) \quad (7),$$

$$FBIAS_{i,j} = f(CV_i, CV_j, CV_{i,j}, \frac{\boldsymbol{CR_j}}{\boldsymbol{f(CR_i)}}) \quad (8).$$

Following Giofré (2014b), the ratio $\frac{CR_j}{f(CR_i)}$ denotes the creditor protection in the destination country CR_j relative to the function of domestic creditor protection $f(CR_i)$. Under the assumption of information asymmetries, investors who are less informed about investor protection abroad than about investor protection at home are supposed to attach a disproportionately high importance to the domestic investor protection that serves as a benchmark against which the host country's investor protection is evaluated (Giofré, 2014b). In this case, I expect a positive coefficient estimate on the absolute and relative differences between creditor protections in host and home countries $CR_j - CR_i$ and $\frac{CR_j}{f(CR_i)}$.

In addition, I further elaborate on the "good country bias" and "comparative corporate governance" theories by exploring whether the difference between domestic and foreign creditor protections indirectly affects foreign investment, i.e. whether the sensitivity of foreign investment to creditor protection depends on the difference between domestic and foreign creditor protections:

$$FBIAS_{i,j} = f(CV_i, CV_j, CV_{i,j}, \boldsymbol{CR_i}, \boldsymbol{CR_j}, \boldsymbol{D * CR_i}, \boldsymbol{D * CR_j}) \quad (9).$$

The dummy variable D is supposed to capture the "comparative effect": It takes the value of one if domestic creditor protection is higher than creditor protection abroad, and zero otherwise:

$$D = \begin{cases} 1 \ if \ \ CR_i > CR_j \\ 0 \ if \ CR_i \leq CR_j \end{cases} \quad (10).$$

The coefficient estimates on the interaction terms $D * CR_i$ and $D * CR_j$, designated as $\delta^{CR\_home\_D}$ and $\delta^{CR\_host\_D}$, reflect the sensitivity of foreign investment to the level of creditor protection in home and host countries. The sensitivity is assumed to depend on a direct comparison between domestic and foreign creditor protections. Thus, the total effects of domestic and foreign creditor protections on foreign investment can be summarized as:

$$\frac{\partial FBIAS_{i,j}}{\partial CR_i} = \begin{cases} \delta^{CR\_home} + \delta^{CR\_home\_D} \ if \ \ CR_i > CR_j \\ \delta^{CR\_home} \ if \ CR_i \leq CR_j \end{cases} \quad (11),$$

$$\frac{\partial FBIAS_{i,j}}{\partial CR_j} = \begin{cases} \delta^{CR\_host} + \delta^{CR\_host\_D} \ if \ \ CR_i > CR_j \\ \delta^{CR\_host} \ if \ CR_i \leq CR_j \end{cases} \quad (12).$$

4 Results

Main estimation results

As a preliminary analysis, Eq. (3) is estimated without the interaction term $CR_i * CR_j$ for the creditor rights index of Djankov et al. (2007) in column (1) of Table 4. Domestic creditor protection CR_i exerts a positive and highly significant impact on international diversification. The positive coefficient on CR_i does not support the theory of Giannetti and Koskinen (2010) who argue that investors whose rights are efficiently protected by domestic legislation are less willing to diversify their portfolios abroad. The estimation results indicate that when creditor protection in the home country deteriorates there is no "flight to quality" effect in the sense that investors rebalance their portfolios away from domestic bonds and increase their foreign bond holdings. On the contrary, a deterioration of creditor protection at home is accompanied by a reduction in foreign investment. The positive direct effect of domestic creditor protection is, however, compatible with the results of Giofré (2014a) for the bilateral equity investment.[14] The coefficient estimate on creditor protection in the host country CR_j is negative, but only marginally significant. The negative sign is not consistent with the preliminary analysis based on correlations (Table 3) and is counterintuitive suggesting that an efficient protection of creditor rights in the destination country deters the cross-border investment.

Columns (2) and (3) of Table 4 report the estimation results based on Eq. (3) that accounts for creditor protections in host and home countries, CR_i and CR_j, and additionally includes the interaction effect between the creditor rights indices in home and host countries, $CR_i * CR_j$. Once the interaction effect $CR_i * CR_j$ is included, the coefficient on the creditor rights index in the destination country has the expected positive sign. The direct effect of domestic creditor protection on international diversification (i.e. the coefficient estimate on CR_i) remains positive and highly significant. The economic significance is considerable: One point increase in the creditor rights index of the home country (that ranges from zero to four) increases the foreign bias by 0.35.[15] The interaction variable $CR_i * CR_j$ enters with a highly significant negative sign.

The negative indirect effect of domestic creditor protection is consistent with the evidence of Giofré (2014a) for the bilateral equity investment. Not only the shareholders, but also the bondholders are less sensitive to the protection of their rights abroad, the more their rights are

[14] Giofré (2014a) finds that, once the interaction term is included, cross-border equity allocations increase with the domestic antidirector rights index.

[15] The average foreign bias of all investing countries over the 2004-2012 period amounts to -2.84. The negative value indicates underinvestment in foreign bonds compared to the optimal benchmark, i.e. the weight in the world debt market capitalization. Thus, an increase in the creditor rights index by one point corresponds to a reduction in underinvestment by 0.35.

protected in their home countries. When domestic creditor protection increases by one point, the positive (albeit not always significant) effect of the destination country's creditor protection on the foreign bias (that is captured by δ^{CR_host} that amounts to 0.05-0.16) falls by 0.04-0.05. In other words, a high creditor protection in the home country has a negative effect on the positive relationship between creditor protection in destination countries and cross-border investment.[16]

The impact of control variables is broadly consistent with expectations. Countries with high sovereign credit ratings, more efficient judicial systems and more developed international bond markets attract more foreign investment and are characterized by a higher degree of international diversification (i.e. higher foreign bias levels). Investors from developed countries also hold more internationally diversified bond portfolios. Geographical distance that is associated with more pronounced information asymmetries decreases foreign investment. A high correlation between home and host bond market returns that implies lower diversification benefits deters foreign investment. Common language, common legal origin and a common membership in the EMU, ASEAN and MERCOSUR increase international diversification in bond markets. However, credit depth of information, capital account liberalization and common border exert a counterintuitive effect on the foreign bias.

Robustness checks

Column (4) of Table 4 reports the estimation results for Eq. (4) that substitutes the home country-specific control variables CV_i by the domestic bias $DBIAS_i$. The direct effect of domestic creditor protection remains positive and highly significant. The indirect effect of domestic creditor protection (i.e. the interaction variable $CR_i * CR_j$) retains its negative sign, but is now only marginally significant. Creditor protection in the destination country CR_j has the expected positive sign, but is not statistically significant.

In Table 4, the estimations are based on the creditor rights index of Djankov et al. (2007) as a proxy for the protection of creditor rights and the results are based on the OLS with robust standard errors (reported in parentheses) and dummy variables that account for time effects. In order to account for both time-series and cross-sectional information, Eq. (3) is re-estimated by means of the FGLS for panel data under the assumption of a heteroskedastic error structure with no cross-sectional correlation in Table 5. Columns (1)-(4) of Table 5 report the estimation results for different proxies for the protection of creditor rights: the creditor rights index of

[16] It has to be pointed out that adding the interaction term $CR_i * CR_j$ to the creditor protections of home and host countries CR_i and CR_j adds little explanatory power to the whole model, i.e. the adjusted R-squared increases only marginally in columns (3) and (4) compared to column (1) of Table 4. However, the negligible increase in the adjusted R-squared can also be observed in Giofré's (2014a) estimations for equity markets.

Djankov et al. (2007), the strength of legal rights index of the World Bank, the efficiency of debt enforcement of Djankov et al. (2008) and the recovery rate of the World Bank's *Doing Business*. With the exception of the efficiency of debt enforcement and recovery rate, the results are consistent with main findings: The coefficient estimates on CR_i ($CR_i * CR_j$) remain positive (negative) and highly significant.

La Porta et al. (1998) emphasize the importance of law enforcement and argue that active and impartial courts may compensate bondholders for a weak protection of creditor rights. Thus, I explore the direct and indirect effects of the efficiency of judicial system, Law_i, Law_j and $Law_i * Law_j$, approximated by the rule of law index of the World Bank and the integrity of legal system of the EFW in columns (5) and (6) of Table 5.[17] The results are consistent with previous estimations: The direct effects of CR_i, CR_j, Law_i and Law_j are positive, whereas the coefficient estimates on the interaction variables $CR_i * CR_j$ and $Law_i * Law_j$ are negative and highly significant.

The subprime crisis and the subsequent eruption of the euro area sovereign debt crisis may have affected the validity of results for the total sample that spans a time period from 2004 to 2012. In times of crisis, agents' uncertainty, risk aversion and information asymmetries increase. Moreover, although relatively stable over time, familiarity considerations may also become more relevant (Giannetti and Laeven, 2012). As a consequence, the importance attached to investor protection that is closely linked to familiarity and information asymmetries may increase in times of crisis. For instance, the ambiguity aversion is likely to make investors particularly demanding about the protection of their rights in foreign countries. To explore the potential differences, Eq. (3) is estimated for the pre-crisis (2004-2006) and crisis (2007-2012) periods based on the creditor rights indices of Djankov et al. (2007) in columns (1a) and (1b) of Table 6. Although the magnitude is slightly higher in the pre-crisis period, the coefficient estimate on the domestic creditor protection CR_i is positive and highly significant both in the pre-crisis and crisis samples. The lower magnitude of the direct impact of CR_i in the crisis period (compared to the pre-crisis period) is consistent with the "flight home effect" that predicts a decreased appetite for foreign investment when payment profiles are more difficult to evaluate during the periods of increased uncertainty. The coefficient on the interaction variable $CR_i * CR_j$ remains negative and significant, albeit only marginally significant in the pre-crisis sample.

[17] In all preceding regression specifications, the rule of law index of host and home countries have always been included among the control variables CV_i and CV_j.

Different sample specifications

Boubakri and Ghouma (2010) argue that there is a pronounced heterogeneity in the protection of creditor rights, especially between developed and developing countries. Given that the dummy variable that differentiates between developed and developing investing countries is highly significant in all regression specifications, Eq. (3) is re-estimated for developed and developing investing countries. The results are reported in columns (2a) and (2b) of Table 6.

For developed countries, the results for CR_i and $CR_i * CR_j$ are consistent with the total sample: The direct effect of the domestic creditor protection CR_i on cross-border bond investment is positive, whereas the investors' sensitivity to the creditor protection abroad declines with the level of domestic creditor protection, i.e. the coefficient estimate on $CR_i * CR_j$ is negative. By contrast, the results are completely different when the cross-border investment of developing investing countries is considered. For these countries, the direct effect of domestic creditor protection on the foreign bias is negative: Investors from countries where their rights are insufficiently protected prefer to diversify abroad. However, there is little evidence that the level of creditor protection in the destination country matters. Neither the host country's creditor protection CR_j nor the interaction variable $CR_i * CR_j$ have any significant effect on the foreign bias of developing countries.

The detected differences between developed and developing countries may be due to the fact that developed countries, in general, offer a higher level of creditor protection to domestic shareholders than developing countries. Indeed, the average creditor rights index amounts to 2.14 (1.6) for developed (developing) sample countries. Therefore, I examine whether the direct and indirect effects of domestic creditor protection vary with the level of domestic creditor protection. For this purpose, the total sample is split into investing countries with creditor protection above and below the world average creditor rights index of Djankov et al. (2007).

For investing countries that display comparatively high, i.e. above the world average, levels of domestic creditor protection, the results are the same as for the total sample (column (1a) of Table 7). In these countries, the direct effect of domestic creditor protection on the foreign bond bias is positive (i.e. CR_i is positively related to international diversification), whereas the coefficient estimate on the interaction variable $CR_i * CR_j$, which determines the sensitivity of foreign investment to the creditor protection in a destination country, is negative. By contrast, the effect of domestic creditor protection on foreign bias is negative for investing countries that offer only a relatively low, i.e. below the world average, level of creditor protection: In these countries, a high level of creditor protection at home deters international diversification and an insufficient protection of creditor rights by domestic legislation induces bondholders to increase

their foreign bond holdings (column (1b) of Table 7). There is no evidence that domestic creditor protection affects the investors' sensitivity to foreign creditor protection for investing countries with creditor protection below the world average: The coefficient estimate on the interaction variable $CR_i * CR_j$ is not significant in this subsample.

Thus, it seems that the twofold effect of domestic creditor protection manifests itself only in investing countries that offer a relatively high level of creditor protection. By contrast, the level of creditor protection in destination countries does not appear to affect the initial results: Columns (2a) and (2b) of Table 7 differentiate between destination countries with creditor protections above and below the world average. In both subsamples, there is strong evidence of a twofold effect of domestic creditor protection on foreign bias: Both the direct and indirect effects, δ^{CR_home} and δ^{int}, bear opposite signs and are highly significant.

Domestic and foreign investor protection: a comparative effect

It is rather puzzling that, compared to the creditor protection in destination countries, the direct effect of domestic creditor protection on foreign investment is more robust and its economic and statistical significance is higher.[18] The coefficient estimates on different proxies for the protection of creditor rights in destination countries bear the expected positive and statistically significant sign only in seven out of 18 regression specifications.[19] One potential explanation may be the fact that the creditor rights index of Djankov et al. (2007), which reflects the protection of secured creditors, may only insufficiently capture the interests of bondholders who are a heterogeneous group (Giofré, 2013). When the efficiency of legal enforcement of the host country Law_j is considered, it is highly economically and statistically significant and has the expected positive sign in most regression specifications. Nonetheless, its economic significance is, in general, lower compared to the economic significance of the efficiency of legal enforcement of the home country Law_i. Another potential explanation for the estimation results concerning the creditor protection in destination countries may be that it is not the creditor protection of the destination country alone, but some function that relates the foreign to the domestic creditor protection that determines the foreign portfolio allocations. This idea is the basis of the "comparative corporate governance" theory of Giofré (2014b) who shows that it is

[18] In order to ensure that the strong positive effect of the domestic creditor protection does not arise as a consequence of the omitted variable bias, a variety of home country-specific control variables have been introduced. Pradkhan (2016) shows that patriotism and cultural variables are important determinants of the foreign bond bias. The strong positive effect still remains when patriotism and cultural variables are introduced. The estimation results for regression specifications that include patriotism and uncertainty avoidance are available on demand.

[19] The lack of significance of creditor protection in destination countries is consistent with the results of Giofré (2013) who also finds only a limited evidence of a significant impact of the host country's creditor protection on the foreign bias in bonds. Similarly, Giofré (2013) frequently faces a counterintuitive negative effect of the host country's creditor protection on foreign bond bias.

the ratio of foreign to domestic investor protection that is crucial for foreign investment decisions in equity markets.

Thus, instead of CR_i and CR_j, it is examined whether it is the absolute and/or relative difference between creditor protections in host and home countries, $CR_{ABS}^{DIF} = CR_j - CR_i$ and/or $CR_{REL}^{DIF} = \frac{CR_j}{CR_i}$, that determine the international portfolio allocations in bond markets, i.e. whether the bondholders' decisions on foreign portfolio allocations are influenced by a direct comparison of the creditor protection in a host country with the creditor protection at home. Tables 8a and 8b report the estimation results based on Eq. (7) and (8).[20] Different proxies for creditor protection are used: the creditor rights index of Djankov et al. (2007),[21] the strength of legal rights index of the World Bank, the efficiency of debt enforcement of Djankov et al. (2008), the rule of law of the World Bank and the integrity of legal system of the EFW.

If investors display a preference towards bonds issued in the destination countries that offer a more efficient protection of their rights than their home country, we should expect a positive impact of CR_{ABS}^{DIF} and CR_{REL}^{DIF} on international diversification. However, the opposite is the case: The more efficient the creditor protection at home compared to the creditor protection in a destination country is, the higher is the investment in bonds issued in this destination country (Tables 8a and 8b). It seems that the positive effect of domestic creditor protection dominates any simple comparison between creditor protections at home and abroad. The ratio of foreign to domestic creditor protection $\frac{CR_j}{CR_i}$ exerts the expected positive impact on cross-border investment only for the rule of law index, in which case the economic significance is close to zero (column (5) of Table 8b). In the remaining regression specifications, the coefficient estimates on CR_{ABS}^{DIF} and CR_{REL}^{DIF} have a counterintuitive, highly significant negative effect on foreign bias (columns (1)-(6) of Table 8a and columns (1)-(4) of Table 8b).

The obtained results indicate that neither the "good country bias" of Giannetti and Koskinen (2010) nor the "comparative corporate governance theory" of Giofré (2014b) hold in bond markets. At least, it is not the foreign relative to the domestic creditor protection or the absolute difference between foreign and domestic creditor protections that increase the cross-border foreign investment. The negative impact of CR_{ABS}^{DIF} and CR_{REL}^{DIF} on $FBIAS_{i,j}$ can be explained by

[20] Table 8b reports the estimation results for Eq. (8) for $f(CR_i) = CR_i$. Different function specifications ($f(CR_i) = CR_i^2$ and $f(CR_i) = \ln(CR_i)$) lead to similar results. Estimations for alternative specifications of $f(CR_i)$ are available on demand.

[21] Modified creditor rights indices of Djankov et al. (2007) are used in column (1) of Table 8b as CR_i and CR_j: A value of one is added to the original creditor rights indices that range from zero to four in order to avoid values of zero in the denominator. Thus, the modified creditor rights indices of Djankov et al. (2007) range from one to five.

the strong positive effect of domestic creditor protection CR_i on foreign bias: It appears that the role of domestic creditor protection in foreign investment decisions is not restricted to a simple benchmark against which the foreign creditor protection is evaluated.

The "comparative corporate governance theory" as suggested by Giofré (2014b) and the "good country bias" of Giannetti and Koskinen (2010) may manifest themselves in the sense that the difference between domestic and foreign creditor protections does not affect the foreign bias directly, but impacts the sensitivity of foreign bias to the level of creditor protection in home and host countries. Thus, as an alternative to the regression specification proposed by Giofré (2014b), I explore how the difference between domestic and foreign creditor protections affects the sensitivity of foreign bond investment to domestic and foreign creditor protections (Eq. (9)).

Table 9 reports the estimation results based on Eq. (9) for different proxies for creditor protection. In most regression specification, the coefficient on $D * CR_j$ is negative ($\delta^{CR\_host\_D} < 0$). This result confirms the hypothesis that a comparatively high domestic creditor protection (relative to the creditor protection in the destination country) reduces the sensitivity of foreign investment to the creditor protection abroad. This effect is so strong that it practically cancels the positive effect of the creditor protection in the destination country, i.e. $\left|\delta^{CR\_host}\right| < \left|\delta^{CR\_host\_D}\right|$ in columns (1), (2), (5) and (6) of Table 9. This result is consistent with the negative interaction effect: Investors from countries with a comparatively high level of creditor protection display a lower sensitivity to the creditor protection in the destination country. The interaction term for domestic creditor protection $D * CR_i$ is positive in most regression specifications: Foreign investment is higher for investors from countries where the home country offers a higher level of creditor protection than the destination country.

5 Conclusion

Giofré (2014a) documents a twofold effect of domestic corporate governance on cross-border investment in equities: On the one hand, domestic shareholder protection increases the preference for foreign stocks (positive direct effect of domestic investor protection). On the other hand, domestic shareholder protection reduces the positive effect of foreign shareholder protection on international diversification (negative indirect effect of domestic investor protection). This study shows that the results of Giofré (2014a) also hold with respect to international diversification in bond portfolios, but not unrestrictedly.

The reduced responsiveness to the creditor protection in destination countries, i.e. the negative indirect effect of domestic creditor protection, is particularly pronounced in investing countries where the protection of creditor rights is relatively high, i.e. above the world average. By

contrast, for countries with a comparatively low protection of creditor rights, domestic creditor protection does not affect the sensitivity of foreign investment to the creditor protection in destination countries. Similarly, there are also differences concerning the direct effect of domestic creditor protection on foreign investment. In countries with a protection of creditor rights above the world average, international diversification in bond portfolios increases with the level of domestic creditor protection (positive direct effect of domestic creditor protection). By contrast, a high level of domestic creditor protection makes foreign investment less attractive for investing countries characterized by a creditor protection below the world average (negative direct effect of domestic creditor protection). For equity markets, Giofré (2014a) does not detect any comparable heterogeneity, possibly due to the fact that her sample includes only developed investing countries.

Furthermore, this study shows that the difference between domestic and foreign creditor protections matters for the foreign investment decisions. However, the "good country bias" theory of Giannetti and Koskinen (2010) and the "comparative corporate governance" theory of Giofré (2014b) that have been developed for equity markets cannot be applied to the foreign bond bias: Neither the difference between the levels of creditor protection in home and host countries nor the ratio of the foreign to the domestic creditor protection deliver meaningful results when a direct effect on the foreign bias is considered. As opposed to equity markets, domestic investor protection appears to be more than a simple benchmark against which the foreign investor protection is evaluated in bond markets. On the contrary, the positive effect of domestic creditor protection on foreign bond bias is both economically and statistically more significant than the positive effect of the creditor protection in destination countries. Albeit not directly affecting the foreign bond bias, the difference between domestic and foreign creditor protections influences the sensitivity of foreign investment to domestic and foreign creditor protections. A domestic creditor protection that is higher than creditor protection in the destination country reduces (increases) the sensitivity of foreign investment to foreign (domestic) creditor protection. The fact that a comparatively high level of domestic creditor protection reduces the foreign investment's sensitivity to the creditor protection in the host country is closely related to the negative indirect effect of domestic creditor protection.

The negative indirect effect of domestic creditor protection can be explained in the context of decreasing marginal returns on investor protection. Given that the portfolios are biased towards domestic assets, an efficient domestic protection of investor rights contributes substantially to the optimal investor protection level in the portfolio such that less attention is paid to investor protection in destination countries (Giofré, 2014a). This theory would also explain why domestic creditor protection does not affect the responsiveness of foreign investment to the

creditor protection in destination countries for investors from countries with creditor protection below the world average. Only when domestic creditor protection is high, a portfolio biased towards domestic securities has a sufficiently high, close to the optimal level of creditor protection and this is not the case for investors from countries that offer only a poor, relative to the world average, protection of creditor rights.

The "decreasing marginal returns" theory may also explain the positive direct effect of domestic creditor protection on cross-border investment for investing countries with relatively high levels of domestic creditor protection. If domestic creditor protection is high, the optimal level of the creditor protection in the total portfolio is already achieved by investing in a low fraction of domestic securities such that a higher fraction of the total portfolio can be allocated to foreign debt securities. The positive direct effect of domestic creditor protection on foreign investment may also reflect the fact that investors from countries with more developed bond markets are more open to international diversification - under the assumption that an efficient protection of creditor rights at home is positively correlated with the bond market development. This is not the case for investing countries with creditor protection below the world average. In investing countries with comparatively low levels of the protection of creditor rights, the negative direct effect of domestic creditor protection may indicate a substitution effect between domestic and foreign bond investment: Investors from countries that offer only a relatively inefficient protection of creditor rights tilt their portfolios towards domestic assets in response to a rising creditor protection in the domestic bond market and diversify abroad when domestic creditor protection deteriorates. As a consequence, we observe a negative relationship between domestic creditor protection and international diversification in countries with a relatively poor protection of creditor rights.

Yield considerations may also explain the positive direct effect of domestic creditor protection on the foreign bond bias in countries with creditor protection above the world average. Under the assumption that the benefits related to a high level of creditor protection are reflected in lower yields, the strong positive relationship between domestic creditor protection and international diversification may be the consequence of a preference towards high-risk jurisdictions that permit obtaining higher yields as opposed to comparatively low yields associated with a low risk at home. Importantly, this effect holds only for countries that offer a comparatively high, i.e. above the world average, protection of creditor rights.

Another potential explanation for the negative indirect effect of domestic creditor protection may stem from behavioral finance. Cao et al. (2011) model the familiarity bias as the tendency to evaluate investment decisions that deviate from a focal choice option, known as *status quo*, with an unduly high skepticism. In the theoretical framework of Cao et al. (2011), a portfolio

composed entirely of domestic assets is assumed to be the *status quo*. In this case, a reluctance to shift investment towards foreign assets reflects the investors' unwillingness to deviate from the *status quo*. The negative indirect effect of domestic creditor protection on international diversification may reflect the comparison between the *status quo* (i.e. the given level of domestic creditor protection associated with a portfolio heavily biased towards domestic assets) and the alternative (i.e. investing more in a destination country's assets and, thus, increasing the weight of the destination country-specific creditor protection). The preference for the *status quo* reduces the sensitivity of foreign investment to the creditor protection in foreign countries: Even if the creditor protection in a host country improves, the shift towards debt securities issued in this host country is not as strong as it would be in the absence of the familiarity bias. Importantly, the framework of Cao et al. (2011) departs from the traditional assumption that foreign assets are associated with a greater uncertainty than domestic assets and show that, even under the assumption of an identical distribution of payoff outcomes, the effect of the familiarity bias increases with the level of uncertainty. This may help explaining the positive direct effect of domestic creditor protection on international diversification: A high level of creditor protection at home is associated with less uncertainty and, thus, with a greater international diversification. However, the familiarity bias of Cao et al. (2011) does not fully explain the observed heterogeneity between investing countries with high and low levels of creditor protection.

The fact that domestic creditor protection reduces the foreign investment's sensitivity to foreign creditor protection for countries that are characterized by high levels of creditor protection as well as the negative direct effect of domestic creditor protection on international diversification in countries that offer only a comparatively weak protection of creditor rights challenge the typical explanation of home bias in terms of diversification costs that investors face vis-à-vis foreign assets. It seems that not only host country-specific characteristics such as an inefficient protection of creditor rights and a low quality of legal environment deter the foreign investment, but also the perception of domestic legal environment may implicitly increase the diversification costs and become a barrier to the foreign investment. These findings may have important policy implications. An improvement in the protection of creditor rights at home reduces international diversification in countries with creditor protection below the world average. In addition, trying to improve creditor protection in the hope of making domestic bonds more attractive to foreign investors from countries that offer a high protection of creditor rights may not achieve the desired outcome: Investors from countries where their rights are well protected do not pay much attention to the creditor protection in the destination country. Future research may explore whether the documented effects of domestic creditor protection on the cross-border investment hold uniformly for institutional and individual investors.

References

Anderson, C.W., Fedenia, M., Hirschey, M., Skiba, H. (2011). Cultural influences on home bias and international diversification by institutional investors. Journal of Banking and Finance, 35, 916-934.

Beugelsdijk, S., Frijns, B. (2010). A cultural explanation of the foreign bias in international asset allocation. Journal of Banking and Finance, 34, 2121-2131.

Boubakri, N., Ghouma, H. (2010). Control/ownership structure, creditor rights protection, and the cost of debt financing: International evidence. Journal of Banking and Finance, 34, 2481-2499.

Cao, H.H., Han, B., Hirshleifer, D., Zhang, H.H. (2011). Fear of the unknown: Familiarity and economic decisions. Review of Finance, 15, 173-206.

Chan, K., Covrig, V., Ng, L. (2005). What determines the domestic bias and foreign bias? Evidence from mutual fund equity allocations worldwide. The Journal of Finance, 60, 1495-1534.

Choi, S.J., Gulati, M., Posner, E.A. (2011). Pricing terms in sovereign debt contracts: a Greek case study with implications for the European crisis resolution mechanism. Chicago Working Paper Series. Accessed July 2015, available at: http://www.zerohedge.com/sites/default/files/images/user5/imageroot/2012/01/Pricing%20Terms%20in%20Sovereign%20Debt%20Contracts%20-%20A%20Greek%20Case.pdf.

Choi, S.J., Gulati, M., Posner, E.A. (2012). The evolution of contractual terms in sovereign bonds. Journal of Legal Analysis, 4, 131-179.

Dahlquist, M., Pinkowitz, L., Stulz, R.M., Williamson, R. (2003). Corporate governance and the home bias. Journal of Financial and Quantitative Analysis, 38, 87-110.

De Moor, L., Vanpée, R. (2013). What drives international equity and bond holdings? An empirical study. Applied Financial Economics, 23, 1067-1082.

Djankov, S., McLiesh, C., Shleifer, A. (2007). Private credit in 129 countries. Journal of Financial Economics, 84, 299-329.

Djankov, S., Hart, O., McLiesh, C., Shleifer, A. (2008). Debt enforcement around the world. Journal of Political Economy, 116, 1105-1149.

Economic Freedom of the World (2013). Appendix explanatory notes and data sources, Fraser Institute. Accessed July 2015, available at: http://object.cato.org/pubs/efw/efw2013/efw-2013-appendix.pdf.

Ferreira, M.A., Miguel, A.F. (2011). The determinants of domestic and foreign bond bias. Journal of Multinational Financial Management, 21, 279-300.

Fidora, M., Fratzscher, M., Thimann, C. (2007). Home bias in global bond and equity markets: The role of real exchange rate volatility. Journal of International Money and Finance, 26, 631-655.

Gehrig, T. (1993). An information based explanation of the domestic bias in international equity investment. Scandinavian Journal of Economics, 95, 97-109.

Giannetti, M., Koskinen, Y. (2010). Investor protection, equity returns, and financial globalization. Journal of Financial and Quantitative Analysis, 45, 135-168.

Giannetti, M., Laeven, L. (2012). The flight home effect: Evidence from the syndicated loan market during financial crises. Journal of Financial Economics, 104, 23-43.

Giannetti, M., Simonov, A. (2006). Which investors fear expropriation? Evidence from investors' portfolio choices. The Journal of Finance, 61, 1507-1547.

Giofré, M. (2013). Investor protection rights and foreign investment. Journal of Comparative Economics, 41, 506-526.

Giofré, M. (2014a). Domestic investor protection and foreign portfolio investment. Journal of Banking and Finance, 46, 355-371.

Giofré, M. (2014b). Comparative corporate governance and international portfolios. The European Journal of Finance, forthcoming.

IMF (2002). Coordinated portfolio investment survey guide. Second Edition. Accessed July 2015, available at: https://www.imf.org/external/pubs/ft/cpis/2002/pdf/cpis_index.pdf.

Kaufmann, D., Kraay, A., Mastruzzi, M. (2010). The worldwide governance indicators: Methodology and analytical issues. World Bank Development Research Group. Accessed July 2015, available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1682130.

Lane, P.R., Milesi-Ferretti, G.M. (2004). International investment patterns, IMF Working Paper, WP/04/134. Accessed July 2015, available at:
https://www.imf.org/external/pubs/ft/wp/2004/wp04134.pdf.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., Vishny, R.W. (1998). Law and finance. Journal of Political Economy, 106, 1113-1155.

Leuz, C., Lins, K.V., Warnock, F.E. (2009). Do foreigners invest less in poorly governed firms? The Review of Financial Studies, 22, 3245-3285.

Lewis, K.K. (1999). Trying to explain home bias in equities and consumption. Journal of Economic Literature, 37, 571-608.

Miller, D.P., Puthenpurackel, J.J. (2002). The costs, wealth effects, and determinants of international capital raising: Evidence from public Yankee bonds. Journal of Financial Intermediation, 11, 455-485.

Portes, R., Rey, H., Oh, Y. (2001). Information and capital flows: The determinants of transactions in financial assets. European Economic Review, 45, 783-796.

Pradkhan, E. (2016). Impact of culture and patriotism on home bias in bond portfolios. Review of Managerial Science, 10, 256-301.

Sercu, P. (1980). A generalization of the international asset pricing model. Revue de l'Association Française de Finance, 1, 91-135.

Yadav, Y. (2014). Empty creditors and sovereign debt: What now? Capital Markets Law Journal, 9, 103-120.

Appendix

Table 1: Foreign bond bias and creditor protection

Home Country	Average foreign bias $\overline{FBIAS_i}$ (2004-2012 average)	Domestic bias (2004-2012 average)	Creditor rights index	Strength of legal rights index	Recovery rate	Efficiency of debt enforcement	Rule of law	Integrity of legal system
Argentina	-5.96	6.23	1	4	31.1	35.8	-0.66	4.2
Australia	-3.00	3.96	3	9	80	87.8	1.75	9.3
Austria	-1.17	4.23	3	7	72.6	78	1.86	10.0
Belgium	-2.24	4.00	2	5	86.5	90.8	1.32	8.3
Brazil	-8.05	4.03	1	3	10.7	13.4	-0.27	3.5
Canada	-3.44	3.79	1	7	89.6	93.2	1.76	9.6
Chile	-3.12	6.38	2	4	27.6	40.9	1.29	8.1
Colombia	-4.36	6.80	0	5	55.3	64.8	-0.47	2.8
Czech Republic	-2.79	6.54	3	6	27.1	40.7	0.89	8.3
Denmark	-1.76	4.36	3	9	77.8	76.7	1.94	10.0
Finland	-1.00	5.02	1	8	88.4	92.4	1.95	10.0
France	-1.62	2.46	0	4	45.9	54.1	1.45	8.3
Germany	-1.39	2.41	3	7	82.0	57	1.67	8.3
Greece	-2.76	4.88	1	4	44.4	53.8	0.71	7.3
Hong Kong	-1.47	5.08	4	10	80.4	88.3	1.54	8.2
Hungary	-5.27	6.61	1	7	38.3	46.7	0.82	6.7
Indonesia	-4.90	6.55	2	5	21.4	25.1	-0.68	4.9
Israel	-4.24	6.01	3	9	50.5	66.2	0.87	8.3
Italy	-2.54	2.90	2	3	57.6	45.3	0.42	6.6
Japan	-2.56	1.69	2	6	92.6	95.5	1.30	8.3
Malaysia	-4.27	5.78	3	10	39.8	48.4	0.51	6.6
Mexico	-5.66	5.10	0	5	64.8	72.6	-0.53	4.2
Netherlands	-0.93	2.89	3	6	86.3	94.9	1.78	10.0
Norway	-1.31	4.54	2	6	90.5	91.8	1.93	10.0
Peru			0	6	27.7	41.8	-0.67	5.2
Philippines	-2.47	6.66	1	4	4.3	17.5	-0.52	4.0
Poland	-3.30	5.82	1	8	33.2	67.7	0.53	7.4
Portugal	-1.43	4.81	1	3	72.5	82.3	1.06	8.3
Russia	-4.28	5.72	2	5	40.9	39	-0.85	6.5
Singapore	-0.83	5.08	3	10	89.7	96.1	1.69	8.3
South Africa	-5.78	6.06	3	7	33.1	39.8	0.10	4.2
Spain	-2.02	3.35	2	6	72.1	82	1.13	8.3
Sweden	-2.48	4.48	1	7	75.8	86	1.90	10.0
Thailand	-3.86	6.06	2	5	42.9	54.9	-0.09	4.2
Turkey	-6.34	5.73	2	5	16.3	6.6	0.09	6.0
UK	-1.10	2.34	4	10	85.8	92.3	1.68	9.0
US	-2.66	0.87	1	9	78.9	85.8	1.57	8.2

Note: The average foreign bias $\overline{FBIAS_i}$ is the equally weighted average foreign bias that a country i displays towards the sample host countries over the 2004-2012 period. The data are averaged over the 2008-2012 period for Chile and over the 2005-2012 period for Malaysia and Mexico. Domestic bias is computed as the log ratio of the actual portfolio weight to the optimal portfolio weight (Eq. (5)). Data on cross-border investment are not available for Peru that is considered only as one of the host countries. The creditor rights index of Djankov et al. (2007) and the efficiency of debt enforcement of Djankov et al. (2008) are as of 2003 and 2006; the rule of law, strength of legal rights, the recovery rate and the integrity of legal system of the EFW are averaged over the 2004-2012 period.

Table 2: Correlations between different proxies for creditor protection and control variables

	Creditor rights index of Djankov et al. (2007)	Legal rights index of the World Bank	Efficiency of debt enforcement of Djankov et al. (2008)	Rule of law index of the World Bank	Integrity of legal system of the EFW	Recovery rate of the World Bank's *Doing Business*
Creditor rights index	1					
Legal rights index	0.50	1				
Efficiency of debt enforcement	0.18	0.56	1			
Rule of law index	0.36	0.60	0.74	1		
Integrity of legal system	0.37	0.47	0.67	0.90	1	
Recovery rate	0.24	0.48	0.93	0.75	0.67	1
Credit depth of information	0.10	0.18	0.13	0.10	0.01	0.16
GDP per capita growth rate	-0.06	-0.16	-0.24	-0.27	-0.24	-0.27
Sovereign stability	0.37	0.59	0.75	0.88	0.79	0.76
Bond market development	0.18	0.29	0.31	0.38	0.31	0.37
Capital account liberalization	0.28	0.19	0.43	0.54	0.54	0.47

Table 3: Correlations between foreign bond bias and creditor protection

	Foreign bias
Creditor rights index (**home** country)	0.22
Strength of legal rights index (**home** country)	0.25
Efficiency of debt enforcement (**home** country)	0.46
Recovery rate (**home** country)	0.47
Rule of law (**home** country)	0.50
Integrity of legal system (**home** country)	0.48
Creditor rights index (**host** country)	0.04
Strength of legal rights index (**host** country)	0.05
Efficiency of debt enforcement (**host** country)	0.05
Recovery rate (**host** country)	0.04
Rule of law (**host** country)	0.11
Integrity of legal system (**host** country)	0.12

***Note*:** Table 3 reports correlations between foreign bias and different proxies for the protection of bondholders in investing (i.e. home) and destination (i.e. host) countries.

Table 4: OLS and creditor rights index of Djankov et al. (2007)

	Creditor rights index of Djankov et al. (2007); Eq. (3) without the interaction term (1)		*Creditor rights index of Djankov et al. (2007); Eq. (3) with the interaction term* (2)		*Creditor rights index of Djankov et al. (2007); Eq. (3) with bank size included as a control variable* (3)		*Creditor rights index of Djankov et al. (2007); Eq. (4) with domestic bias as control variable* (4)	
CR_i *(home)*	**0.275*** **	***(0.02)***	**0.354*** **	***(0.03)***	**0.344*** **	***(0.04)***	**0.589*** **	***(0.04)***
CR_j *(host)*	**-0.031***	***(0.02)***	**0.053**	***(0.04)***	**0.157*** **	***(0.04)***	**0.048**	***(0.04)***
$CR_i * CR_j$			**-0.042*** **	***(0.01)***	**-0.045*** **	***(0.02)***	**-0.033***	***(0.02)***
Home country-specific control variables								
Domestic bias							-0.415***	*(0.01)*
Depth of credit information	-0.312***	*(0.02)*	-0.311***	*(0.02)*	-0.356***	*(0.03)*		
Capital account liberalization	-0.048***	*(0.01)*	-0.049***	*(0.01)*	-0.063***	*(0.01)*		
GDP growth rate	-0.035	*(0.36)*	-0.031	*(0.36)*	-0.450***	*(0.43)*		
Sovereign stability	0.151***	*(0.01)*	0.151***	*(0.01)*	0.150***	*(0.02)*		
Developed dummy	1.203***	*(0.10)*	1.208***	*(0.10)*	1.109***	*(0.13)*		
Bond market development	2.882***	*(0.42)*	2.802***	*(0.42)*	3.432***	*(0.48)*		
Rule of law	0.341***	*(0.07)*	0.339***	*(0.07)*	0.274***	*(0.08)*		
Bank size					0.002***	*(0.00)*		
Host country-specific control variables								
Depth of credit information	-0.144***	*(0.02)*	-0.144***	*(0.02)*	-0.097***	*(0.02)*	-0.122***	*(0.02)*
Capital account liberalization	-0.078***	*(0.01)*	-0.078***	*(0.01)*	-0.072***	*(0.01)*	-0.074***	*(0.01)*
GDP growth rate	1.421***	*(0.31)*	1.414***	*(0.31)*	1.640***	*(0.37)*	1.722***	*(0.35)*
Sovereign stability	0.032***	*(0.01)*	0.032***	*(0.01)*	0.019	*(0.01)*	0.013	*(0.01)*
Developed dummy	-0.107	*(0.09)*	-0.105	*(0.08)*	0.197*	*(0.12)*	-0.199**	*(0.09)*
Bond market development	10.092***	*(0.53)*	9.987***	*(0.53)*	9.617***	*(0.60)*	9.270***	*(0.58)*
Rule of law	0.196***	*(0.05)*	0.195***	*(0.05)*	0.273***	*(0.07)*	0.116*	*(0.06)*
Bank size					-0.005***	*(0.00)*		
Bilateral effects								
Return correlation	-0.945***	*(0.10)*	-0.944***	*(0.10)*	-0.967***	*(0.12)*	-0.101	*(0.12)*
Common legal origin	0.416***	*(0.05)*	0.426***	*(0.05)*	0.388***	*(0.06)*	-0.017	*(0.06)*
Common border	-0.223***	*(0.09)*	-0.231***	*(0.08)*	-0.421***	*(0.09)*	-0.225**	*(0.11)*
Common language	0.597***	*(0.07)*	0.604***	*(0.07)*	0.600***	*(0.09)*	1.143***	*(0.08)*
Common colonial past	0.074	*(0.08)*	0.108	*(0.09)*	0.147	*(0.10)*	0.017	*(0.10)*
Geographical distance	-0.802***	*(0.03)*	-0.805***	*(0.03)*	-0.779***	*(0.03)*	-0.886***	*(0.03)*
EMU	1.486***	*(0.06)*	1.481***	*(0.06)*	1.674***	*(0.07)*	1.618***	*(0.07)*
NAFTA	-0.002	*(0.27)*	0.067	*(0.27)*	0.191	*(0.35)*	-0.197	*(0.28)*
MERCOSUR	1.540***	*(0.28)*	1.585***	*(0.28)*	1.695***	*(0.32)*	-0.128	*(0.31)*
ASEAN	2.339***	*(0.18)*	2.333***	*(0.18)*	2.352***	*(0.19)*	1.271***	*(0.18)*
R-squared adjusted	0.5522		0.5525		0.5679		0.4102	
No. of observations	8431		8431		6205		8431	

Note: The dependent variable is the foreign bias displayed by 36 investing countries over the 2004-2012 period computed based on Eq. (1). The variable of interest CR is the creditor rights index of Djankov et al. (2007).

In column (1), only host and home country-specific control variables, control variables that account for bilateral effects (e.g. information asymmetries) and the creditor rights indices of home and host countries CR_i and CR_j are included. Columns (2)-(4) report the estimation results based on Eq. (3) and (4), respectively. Column (3) reports the estimation results based in Eq. (3) where the bank size is included as an additional control variable. The estimation procedure is ordinary least squares with robust standard errors and time dummies that account for time effects. The constant and time dummies are included, but not explicitly reported. Standard errors are reported in parentheses.

***, ** and * denote significance at one, five and ten percent, respectively.

Table 5: FGLS and different proxies for creditor protection

	Creditor rights index of Djankov et al. (2007)		*Strength of legal rights index*		*Efficiency of debt enforcement of Djankov et al. (2008)*		*Recovery rate (World Bank's Doing Business Report)*		*Creditor rights index of Djankov et al. (2007) as CR and rule of law index as Law*		*Creditor rights index of Djankov et al. (2007) as CR and integrity of legal system as Law*	
	(1)		*(2)*		*(3)*		*(4)*		*(5)*		*(6)*	
CR_i *(home)*	**0.341*****	*(0.02)*	**0.078*****	*(0.02)*	**0.010*****	*(0.001)*	**0.016*****	*(0.001)*	**0.327*****	*(0.02)*	**0.336*****	*(0.02)*
CR_j *(host)*	**0.032****	*(0.02)*	**-0.007**	*(0.02)*	**-0.007*****	*(0.001)*	**-0.0003**	*(0.001)*	**0.027***	*(0.02)*	**0.026**	*(0.02)*
$CR_i * CR_j$	**-0.036*****	*(0.01)*	**-0.006*****	*(0.00)*	**0.0001*****	*(<0.001)*	**0.0001*****	*(<0.001)*	**-0.032*****	*(0.01)*	**-0.038*****	*(0.01)*
Law_i									**0.589*****	*(0.04)*	**0.200*****	*(0.03)*
Law_j									**0.320*****	*(0.03)*	**0.140*****	*(0.03)*
$Law_i * Law_j$									**-0.133*****	*(0.02)*	**-0.013*****	*(0.003)*
Home country-specific control variables												
Depth of credit information	-0.305***	*(0.01)*	-0.248***	*(0.01)*	-0.270***	*(0.01)*	-0.305***	*(0.01)*	-0.303***	*(0.01)*	-0.289***	*(0.01)*
Capital account liberalization	-0.024***	*(0.00)*	-0.004	*(0.00)*	-0.005	*(0.00)*	-0.003	*(0.00)*	-0.023***	*(0.00)*	-0.034***	*(0.004)*
GDP growth rate	-0.216*	*(0.12)*	-0.044	*(0.12)*	-0.146	*(0.12)*	-0.165	*(0.12)*	-0.179	*(0.12)*	-0.303***	*(0.12)*
Sovereign stability	0.129***	*(0.01)*	0.149***	*(0.01)*	0.122***	*(0.01)*	0.119***	*(0.01)*	0.126***	*(0.01)*	0.162***	*(0.01)*
Developed dummy	1.148***	*(0.04)*	1.177***	*(0.04)*	0.672***	*(0.04)*	0.582***	*(0.04)*	1.177***	*(0.04)*	1.396***	*(0.04)*
Bond market development	2.040***	*(0.22)*	1.703***	*(0.23)*	2.854***	*(0.23)*	2.553***	*(0.23)*	2.022***	*(0.22)*	2.089***	*(0.22)*
Rule of law (Law_i)	0.428***	*(0.03)*	0.355***	*(0.03)*	0.298***	*(0.03)*	0.360***	*(0.02)*				
Host country-specific control variables												
Depth of credit information	-0.152***	*(0.01)*	-0.118***	*(0.01)*	-0.133***	*(0.01)*	-0.137***	*(0.01)*	-0.147***	*(0.01)*	-0.139***	*(0.01)*
Capital account liberalization	-0.061***	*(0.00)*	-0.066***	*(0.00)*	-0.068***	*(0.00)*	-0.067***	*(0.00)*	-0.063***	*(0.00)*	-0.065***	*(0.004)*
GDP growth rate	0.646***	*(0.11)*	0.535***	*(0.11)*	0.576***	*(0.11)*	0.600***	*(0.11)*	0.630***	*(0.11)*	0.781***	*(0.10)*
Sovereign stability	0.033***	*(0.01)*	0.029***	*(0.01)*	0.017***	*(0.01)*	0.023***	*(0.01)*	0.031***	*(0.01)*	0.047***	*(0.004)*
Developed dummy	-0.083**	*(0.04)*	-0.119***	*(0.04)*	-0.080**	*(0.04)*	-0.148***	*(0.04)*	-0.065*	*(0.04)*	-0.060*	*(0.03)*
Bond market development	8.101***	*(0.22)*	7.915***	*(0.23)*	8.732***	*(0.22)*	8.601***	*(0.22)*	8.099***	*(0.22)*	8.418***	*(0.22)*
Rule of law (Law_j)	0.144***	*(0.02)*	0.250***	*(0.03)*	0.154***	*(0.03)*	0.152***	*(0.03)*				

Table 5 (continued): FGLS and different proxies for creditor protection

	Creditor rights index of Djankov et al. (2007)		*Strength of legal rights index*		*Efficiency of debt enforcement of Djankov et al. (2008)*		*Recovery rate (World Bank's Doing Business Report)*		*Creditor rights index of Djankov et al. (2007) as CR and rule of law index as Law*		*Creditor rights index of Djankov et al. (2007) as CR and integrity of legal system as Law*	
	(1)		*(2)*		*(3)*		*(4)*		*(5)*		*(6)*	
Bilateral effects												
Return correlation	-0.852***	*(0.04)*	-0.845***	*(0.04)*	-0.807***	*(0.04)*	-0.851***	*(0.04)*	-0.818***	*(0.04)*	-0.879***	*(0.04)*
Common legal origin	0.423***	*(0.02)*	0.461***	*(0.02)*	0.425***	*(0.02)*	0.463***	*(0.02)*	0.459***	*(0.02)*	0.424***	*(0.02)*
Common border	-0.238***	*(0.04)*	-0.217***	*(0.04)*	-0.020	*(0.04)*	-0.174***	*(0.04)*	-0.246***	*(0.03)*	-0.228***	*(0.03)*
Common language	0.569***	*(0.03)*	0.541***	*(0.03)*	0.493***	*(0.03)*	0.474***	*(0.03)*	0.551***	*(0.02)*	0.588***	*(0.03)*
Common colonial past	0.090**	*(0.04)*	0.076*	*(0.04)*	0.034	*(0.04)*	0.144***	*(0.04)*	0.091**	*(0.04)*	0.089**	*(0.05)*
Geographical distance	-0.764***	*(0.01)*	-0.764***	*(0.01)*	-0.757***	*(0.01)*	-0.757***	*(0.01)*	-0.768***	*(0.01)*	-0.765***	*(0.01)*
EMU	1.456***	*(0.03)*	1.375***	*(0.03)*	1.430***	*(0.03)*	1.431***	*(0.03)*	1.438***	*(0.03)*	1.423***	*(0.03)*
NAFTA	0.138	*(0.18)*	-0.374**	*(0.18)*	-0.876***	*(0.16)*	-0.685***	*(0.16)*	0.079	*(0.18)*	-0.009	*(0.18)*
MERCOSUR	1.928***	*(0.17)*	1.650***	*(0.16)*	1.289***	*(0.16)*	1.524***	*(0.16)*	2.191***	*(0.17)*	2.318***	*(0.17)*
ASEAN	2.400***	*(0.12)*	2.545***	*(0.12)*	2.481***	*(0.12)*	2.637***	*(0.12)*	2.559***	*(0.12)*	2.5751***	*(0.12)*
No. of observations	8431		8431		8431		8431		8431		8431	

Note: The dependent variable is the foreign bias displayed by 36 investing countries over the 2004-2012 period. In columns (1)-(4), Eq. (3) is estimated for different proxies for creditor protection: creditor rights index, strength of legal rights index, efficiency of debt enforcement and recovery rate.
In columns (5) and (6), the proxies for the efficiency of law enforcement are singled out from host and home country-specific control variables and are reported separately as $\boldsymbol{Law_i}$ and $\boldsymbol{Law_j}$. In addition, their interaction term $\boldsymbol{Law_i * Law_j}$ is also included in the regression estimations. In column (5), $\boldsymbol{Law}$ is the rule of law index of the World Bank. It is substituted by the integrity of legal system index of the EFW in column (6). As proxies for creditor protection $\boldsymbol{CR_i}$ and $\boldsymbol{CR_j}$, the creditor rights indices of Djankov et al. (2007) are used in columns (5) and (6).
In columns (1)-(6), the estimation procedure is the feasible generalized least squares estimator for panel data under the assumption of a heteroskedastic error structure with no cross-sectional correlation. The constant is included in all regressions, but not explicitly reported. Standard errors are reported in parentheses. ***, ** and * denote significance at one, five and ten percent, respectively.

Table 6: Different sample specifications

	Pre-crisis period (2004-2006) (1a)		*Crisis period (2007-2012) (1b)*		*Developed investing countries (2a)*		*Developing investing countries (2b)*	
CR_i *(home)*	**0.419*** **	***(0.06)***	**0.330*** **	***(0.04)***	**0.340*** **	***(0.03)***	**-0.197** **	***(0.10)***
CR_j *(host)*	**0.040**	***(0.06)***	**0.054**	***(0.05)***	**-0.061***	***(0.03)***	**0.108**	***(0.08)***
$CR_i * CR_j$	**-0.043***	***(0.03)***	**-0.040** **	***(0.02)***	**-0.027** **	***(0.01)***	**0.041**	***(0.04)***
Home country-specific control variables								
Depth of credit information	-0.314***	*(0.04)*	-0.324***	*(0.03)*	-0.203***	*(0.03)*	-0.209***	*(0.05)*
Capital account liberalization	-0.073***	*(0.02)*	-0.040***	*(0.01)*	0.009	*(0.01)*	-0.013	*(0.04)*
GDP growth rate	-2.021***	*(0.76)*	0.687*	*(0.41)*	-0.573	*(0.38)*	2.130***	*(0.67)*
Sovereign stability	0.194***	*(0.03)*	0.131***	*(0.01)*	0.073***	*(0.01)*	0.184***	*(0.02)*
Developed dummy	1.546***	*(0.21)*	1.047***	*(0.11)*				
Bond market development	2.832***	*(0.70)*	3.207***	*(0.54)*	2.178***	*(0.42)*	-460.573***	*(38.71)*
Rule of law	-0.067	*(0.12)*	0.504***	*(0.08)*	0.924***	*(0.07)*	-0.240**	*(0.12)*
Host country-specific control variables								
Depth of credit information	-0.083***	*(0.03)*	-0.185***	*(0.03)*	-0.154***	*(0.02)*	-0.181***	*(0.05)*
Capital account liberalization	-0.092***	*(0.02)*	-0.079***	*(0.01)*	-0.096***	*(0.01)*	-0.041*	*(0.02)*
GDP growth rate	4.049***	*(0.62)*	0.681*	*(0.36)*	1.404***	*(0.30)*	1.545**	*(0.74)*
Sovereign stability	-0.005	*(0.02)*	0.040***	*(0.01)*	0.048***	*(0.01)*	-0.015	*(0.03)*
Developed dummy	0.524***	*(0.19)*	-0.265***	*(0.10)*	0.218***	*(0.08)*	-1.289***	*(0.23)*
Bond market development	9.314***	*(0.86)*	10.705***	*(0.68)*	8.666***	*(0.53)*	14.290***	*(1.11)*
Rule of law	0.225**	*(0.11)*	0.184***	*(0.06)*	0.108**	*(0.05)*	0.548***	*(0.13)*
Bilateral effects								
Return correlation	-0.795***	*(0.19)*	-1.045***	*(0.12)*	-0.655***	*(0.09)*	-1.131***	*(0.26)*
Common legal origin	0.559***	*(0.08)*	0.361***	*(0.06)*	0.661***	*(0.05)*	0.261**	*(0.11)*
Common border	-0.496***	*(0.14)*	-0.108	*(0.10)*	-0.121*	*(0.07)*	-0.165	*(0.23)*
Common language	0.464***	*(0.13)*	0.681***	*(0.09)*	0.187***	*(0.07)*	1.341***	*(0.17)*
Common colonial past	0.007	*(0.15)*	0.132	*(0.11)*	0.124	*(0.08)*	0.084	*(0.21)*
Geographical distance	-0.803***	*(0.05)*	-0.812***	*(0.03)*	-0.617***	*(0.03)*	-1.162***	*(0.06)*
EMU	1.473***	*(0.09)*	1.482***	*(0.07)*	1.618***	*(0.05)*		
NAFTA	-0.551	*(0.53)*	0.321	*(0.31)*	-0.077	*(0.26)*	0.681	*(0.53)*
MERCOSUR	2.515***	*(0.52)*	1.269***	*(0.31)*			0.628**	*(0.31)*
ASEAN	2.249***	*(0.37)*	2.318***	*(0.20)*			1.178***	*(0.23)*
R-squared adjusted	0.5714		0.5473		0.4973		0.4100	
No. of observations	2544		5887		5963		2468	

Note: The dependent variable is the foreign bias computed based on Eq. (1). The estimation period encompasses annual data over the 2004-2012 period. The variable of interest CR is the creditor rights index of Djankov et al. (2007).

The estimation procedure is ordinary least squares with robust standard errors and time dummies that account for time effects (Eq. (3)). The constant and time dummies are included, but not explicitly reported. Standard errors are reported in parentheses.

***, ** and * denote significance at one, five and ten percent, respectively.

Table 7: Creditor protection above and below the world average

	Investing countries with creditor protection above world average (1a)		*Investing countries with creditor protection below world average (1b)*		*Destination countries with creditor protection above world average (2a)*		*Destination countries with creditor protection below world average (2b)*	
CR_i *(home)*	**0.186*****	*(0.07)*	**-0.663*****	*(0.17)*	**0.603*****	*(0.10)*	**0.367*****	*(0.05)*
CR_j *(host)*	**0.198****	*(0.09)*	**-0.108***	*(0.06)*	**0.419*****	*(0.09)*	**0.557*****	*(0.15)*
$CR_i * CR_j$	**-0.090*****	*(0.03)*	**0.094**	*(0.07)*	**-0.115*****	*(0.03)*	**-0.171*****	*(0.06)*
Home country-specific control variables								
Depth of credit information	-0.260***	*(0.03)*	-0.133***	*(0.05)*	-0.413***	*(0.03)*	-0.157***	*(0.04)*
Capital account liberalization	0.031**	*(0.01)*	-0.151***	*(0.02)*	-0.066***	*(0.01)*	-0.027*	*(0.02)*
GDP growth rate	0.805*	*(0.43)*	-0.125	*(0.64)*	0.381	*(0.47)*	-0.182	*(0.55)*
Sovereign stability	0.232***	*(0.02)*	0.117***	*(0.02)*	0.132***	*(0.02)*	0.188***	*(0.02)*
Developed dummy	0.224*	*(0.12)*	2.789***	*(0.18)*	1.188***	*(0.13)*	1.178***	*(0.15)*
Bond market development	3.328***	*(0.60)*	1.866**	*(0.89)*	3.797***	*(0.55)*	1.167*	*(0.63)*
Rule of law	0.637***	*(0.09)*	-0.277*	*(0.15)*	0.450***	*(0.09)*	0.179*	*(0.09)*
Host country-specific control variables								
Depth of credit information	-0.159***	*(0.02)*	-0.133***	*(0.04)*	-0.313***	*(0.03)*	-0.106***	*(0.04)*
Capital account liberalization	-0.066***	*(0.01)*	-0.109***	*(0.02)*	-0.141***	*(0.01)*	-0.035**	*(0.02)*
GDP growth rate	1.049***	*(0.36)*	1.916***	*(0.56)*	1.486***	*(0.42)*	-0.261	*(0.48)*
Sovereign stability	0.043***	*(0.01)*	0.006	*(0.02)*	0.087***	*(0.02)*	0.093***	*(0.02)*
Developed dummy	-0.170*	*(0.10)*	0.099	*(0.15)*	-0.098	*(0.12)*	0.407***	*(0.13)*
Bond market development	8.631***	*(0.61)*	12.538***	*(0.92)*	12.807***	*(0.74)*	3.373***	*(0.84)*
Rule of law	0.222***	*(0.06)*	0.156	*(0.10)*	0.225***	*(0.08)*	-0.504***	*(0.12)*
Bilateral effects								
Return correlation	-1.179***	*(0.13)*	-0.739***	*(0.21)*	-0.989***	*(0.15)*	-1.431***	*(0.14)*
Common legal origin	0.495***	*(0.06)*	0.132	*(0.09)*	0.427***	*(0.07)*	0.487***	*(0.07)*
Common border	-0.241***	*(0.09)*	0.145	*(0.17)*	-0.224**	*(0.10)*	-0.151	*(0.16)*
Common language	0.317***	*(0.09)*	1.337***	*(0.12)*	0.379***	*(0.10)*	0.846***	*(0.11)*
Common colonial past	0.262**	*(0.12)*	-0.574***	*(0.13)*	0.388***	*(0.12)*	-0.473***	*(0.13)*
Geographical distance	-0.743***	*(0.03)*	-1.099***	*(0.06)*	-0.797***	*(0.03)*	-0.977***	*(0.05)*
EMU	1.427***	*(0.07)*	1.257***	*(0.10)*	1.454***	*(0.08)*	1.448***	*(0.09)*
NAFTA			-0.899**	*(0.35)*			-0.658**	*(0.30)*
MERCOSUR	1.957***	*(0.28)*	0.356	*(0.31)*	1.581*	*(0.84)*	0.989***	*(0.29)*
ASEAN	2.189***	*(0.20)*	3.289***	*(0.37)*	2.552***	*(0.19)*	1.045***	*(0.39)*
R-squared adjusted	0.5399		0.5995		0.5582		0.5888	
No. of observations	5413		3018		4990		3441	

Note: The dependent variable is the foreign bias computed based on Eq. (1). The estimation period encompasses annual data over the 2004-2012 period. The variable of interest CR is the creditor rights index of Djankov et al. (2007). The estimation procedure is ordinary least squares with robust standard errors and time dummies that account for time effects (Eq. (3)). The constant and time dummies are included, but not explicitly reported. Standard errors are reported in parentheses.
***, ** and * denote significance at one, five and ten percent, respectively.

Table 8a: Is domestic creditor protection a benchmark against which the foreign creditor protection is evaluated?

	Creditor rights index of Djankov et al. (2007) (1)		*Strength of legal rights index* (2)		*Efficiency of debt enforcement of Djankov et al. (2008)* (3)		*Recovery rate of the World Bank's Doing Business* (4)		*Rule of law index* (5)		*Integrity of legal system* (6)	
$CR^{DIF} = CR_j(host) - CR_i(home)$	**-0.151*** **	***(0.01)***	**-0.037*** **	***(0.01)***	**-0.009*** **	***(0.001)***	**-0.009*** **	***(0.001)***	**-0.095** **	***(0.04)***	**-0.026***	***(0.01)***
Home country-specific control variables												
Depth of credit information	-0.287***	*(0.02)*	-0.264***	*(0.02)*	-0.275***	*(0.02)*	-0.286***	*(0.02)*	-0.244***	*(0.02)*	-0.240*	*(0.02)*
Capital account liberalization	-0.037***	*(0.01)*	-0.020*	*(0.01)*	-0.020*	*(0.01)*	-0.022**	*(0.01)*	-0.023**	*(0.01)*	-0.025*	*(0.01)*
GDP growth rate	0.046	*(0.36)*	0.124	*(0.36)*	0.095	*(0.36)*	0.105	*(0.36)*	-0.019	*(0.36)*	-0.053	*(0.36)*
Sovereign stability	0.160***	*(0.01)*	0.167***	*(0.01)*	0.154***	*(0.01)*	0.149***	*(0.01)*	0.208***	*(0.01)*	0.215***	*(0.01)*
Developed dummy	1.177***	*(0.10)*	1.146***	*(0.10)*	0.902***	*(0.10)*	0.854***	*(0.10)*	1.298***	*(0.09)*	1.312***	*(0.09)*
Bond market development	2.724***	*(0.43)*	2.320***	*(0.44)*	2.976***	*(0.44)*	2.914***	*(0.44)*	2.078***	*(0.44)*	2.064***	*(0.44)*
Rule of law	0.355***	*(0.07)*	0.327***	*(0.07)*	0.332***	*(0.07)*	0.368***	*(0.07)*				
Host country-specific control variables												
Depth of credit information	-0.132***	*(0.02)*	-0.134***	*(0.02)*	-0.116***	*(0.02)*	-0.110***	*(0.02)*	-0.134***	*(0.02)*	-0.139***	*(0.02)*
Capital account liberalization	-0.074***	*(0.01)*	-0.080***	*(0.01)*	-0.079***	*(0.01)*	-0.079***	*(0.01)*	-0.085***	*(0.01)*	-0.083***	*(0.01)*
GDP growth rate	1.534***	*(0.31)*	1.386***	*(0.32)*	1.350***	*(0.32)*	1.380***	*(0.32)*	1.183***	*(0.32)*	1.230***	*(0.32)*
Sovereign stability	0.036***	*(0.01)*	0.038***	*(0.01)*	0.051***	*(0.01)*	0.052***	*(0.01)*	0.065***	*(0.01)*	0.059***	*(0.01)*
Developed dummy	-0.141*	*(0.09)*	-0.169*	*(0.09)*	0.094	*(0.09)*	0.179**	*(0.09)*	0.124	*(0.08)*	0.099	*(0.08)*
Bond market development	10.192***	*(0.54)*	10.157***	*(0.54)*	9.384***	*(0.52)*	9.513***	*(0.53)*	9.617***	*(0.53)*	9.587***	*(0.54)*
Rule of law	0.245***	*(0.05)*	0.235***	*(0.06)*	0.211***	*(0.06)*	0.183***	*(0.05)*				
Bilateral effects												
Return correlation	-0.959***	*(0.10)*	-0.985***	*(0.10)*	-0.952***	*(0.10)*	-0.949***	*(0.10)*	-0.974***	*(0.10)*	-0.973***	*(0.10)*
Common legal origin	0.399***	*(0.05)*	0.393***	*(0.05)*	0.393***	*(0.05)*	0.393***	*(0.05)*	0.334***	*(0.05)*	0.333***	*(0.05)*
Common border	-0.238***	*(0.08)*	-0.226***	*(0.08)*	-0.225***	*(0.08)*	-0.227***	*(0.08)*	-0.248***	*(0.09)*	-0.243***	*(0.09)*
Common language	0.662***	*(0.07)*	0.655***	*(0.07)*	0.657***	*(0.07)*	0.661***	*(0.07)*	0.672***	*(0.07)*	0.672***	*(0.07)*
Common colonial past	0.065	*(0.09)*	0.060	*(0.09)*	0.054	*(0.09)*	0.053	*(0.09)*	0.075	*(0.09)*	0.076	*(0.09)*
Geographical distance	-0.823***	*(0.03)*	-0.811***	*(0.03)*	-0.807***	*(0.03)*	-0.812***	*(0.03)*	-0.851***	*(0.03)*	-0.851***	*(0.03)*
EMU	1.392***	*(0.06)*	1.447***	*(0.06)*	1.437***	*(0.06)*	1.406***	*(0.06)*	1.360***	*(0.05)*	1.354***	*(0.05)*
NAFTA	-0.401	*(0.27)*	-0.427	*(0.27)*	-0.424	*(0.27)*	-0.421	*(0.27)*	-0.562**	*(0.26)*	-0.566*	*(0.26)*
MERCOSUR	1.343***	*(0.27)*	1.375***	*(0.27)*	1.325***	*(0.26)*	1.302***	*(0.26)*	1.407***	*(0.27)*	1.413***	*(0.27)*
ASEAN	2.479***	*(0.18)*	2.499***	*(0.18)*	2.520***	*(0.18)*	2.521***	*(0.18)*	2.361***	*(0.17)*	2.339***	*(0.17)*
R-squared adjusted	0.5483		0.5428		0.5471		0.5459		0.5392		0.5391	
No. of observations	8431		8431		8431		8431		8431		8431	

Note: The dependent variable is the foreign bias. ***CR*** is the creditor rights index of Djankov et al. (2007), the strength of legal rights of the World Bank, the efficiency of debt enforcement Djankov et al. (2008), the recovery rate of the World Bank's *Doing Business*, the rule of law index of the World Bank and the integrity of legal system of the EFW in columns (1)-(6), respectively. The estimation procedure is ordinary least squares with robust standard errors and time dummies that account for time effects. The constant and time dummies are included, but not explicitly reported. Standard errors are reported in parentheses.
***, ** and * denote significance at one, five and ten percent, respectively.

Table 8b: Is domestic creditor protection a benchmark against which the foreign creditor protection is evaluated?

	Creditor rights index of Djankov et al. (2007) (1)		*Strength of legal rights index* (2)		*Efficiency of debt enforcement of Djankov et al. (2008)* (3)		*Recovery rate of the World Bank's Doing Business* (4)		*Rule of law index* (5)		*Integrity of legal system* (6)	
$CR^{DIF} = \frac{CR_j(host)}{CR_i(home)}$	**-0.190*** **	***(0.03)***	**-0.187*** **	***(0.05)***	**-0.225*** **	***(0.02)***	**-0.026*** **	***(0.01)***	**0.004*** **	***(0.001)***	**-0.059**	***(0.06)***
Home country-specific control variables												
Depth of credit information	-0.279***	*(0.02)*	-0.264***	*(0.02)*	-0.286***	*(0.02)*	-0.265***	*(0.02)*	-0.242***	*(0.02)*	-0.241***	*(0.02)*
Capital account liberalization	-0.029***	*(0.01)*	-0.015	*(0.01)*	-0.022**	*(0.01)*	-0.017	*(0.01)*	-0.021**	*(0.01)*	-0.025**	*(0.01)*
GDP growth rate	0.056	*(0.36)*	0.168	*(0.36)*	0.419	*(0.35)*	0.425	*(0.36)*	0.098	*(0.36)*	-0.059	*(0.36)*
Sovereign stability	0.169***	*(0.01)*	0.167***	*(0.01)*	0.117***	*(0.01)*	0.156***	*(0.01)*	0.220***	*(0.01)*	0.218***	*(0.01)*
Developed dummy	1.122***	*(0.10)*	1.165***	*(0.10)*	0.856***	*(0.10)*	1.052***	*(0.10)*	1.352***	*(0.09)*	1.339***	*(0.09)*
Bond market development	2.977***	*(0.44)*	2.409***	*(0.44)*	3.511***	*(0.44)*	2.755***	*(0.44)*	2.024***	*(0.44)*	2.014***	*(0.44)*
Rule of law	0.353***	*(0.07)*	0.300***	*(0.07)*	0.509***	*(0.06)*	0.418***	*(0.06)*				
Host country-specific control variables												
Depth of credit information	-0.139***	*(0.02)*	-0.136***	*(0.02)*	-0.130***	*(0.02)*	-0.140***	*(0.02)*	-0.138***	*(0.02)*	-0.137***	*(0.02)*
Capital account liberalization	-0.077***	*(0.01)*	-0.080***	*(0.01)*	-0.079***	*(0.01)*	-0.079***	*(0.01)*	-0.084***	*(0.01)*	-0.083***	*(0.01)*
GDP growth rate	1.437***	*(0.32)*	1.375***	*(0.32)*	1.363***	*(0.31)*	1.317***	*(0.32)*	1.219***	*(0.32)*	1.230***	*(0.32)*
Sovereign stability	0.034***	*(0.01)*	0.037***	*(0.01)*	0.039***	*(0.01)*	0.034***	*(0.01)*	0.053***	*(0.01)*	0.055***	*(0.01)*
Developed dummy	-0.115	*(0.09)*	-0.157*	*(0.09)*	-0.015	*(0.08)*	-0.077	*(0.09)*	0.053	*(0.08)*	0.066	*(0.08)*
Bond market development	10.172***	*(0.54)*	10.183***	*(0.54)*	9.801***	*(0.53)*	9.925***	*(0.53)*	9.670***	*(0.53)*	9.662***	*(0.53)*
Rule of law	0.210***	*(0.05)*	0.224***	*(0.06)*	0.197***	*(0.05)*	0.176***	*(0.05)*				
Bilateral effects												
Return correlation	-0.967***	*(0.10)*	-0.992***	*(0.10)*	-1.017***	*(0.10)*	-0.990***	*(0.10)*	-0.966***	*(0.10)*	-0.965***	*(0.10)*
Common legal origin	0.388***	*(0.05)*	0.364***	*(0.05)*	0.394***	*(0.05)*	0.377***	*(0.05)*	0.333***	*(0.05)*	0.333***	*(0.05)*
Common border	-0.221***	*(0.08)*	-0.212**	*(0.08)*	-0.226***	*(0.08)*	-0.214**	*(0.08)*	-0.241***	*(0.09)*	-0.241***	*(0.09)*
Common language	0.663***	*(0.07)*	0.655***	*(0.07)*	0.653***	*(0.07)*	0.672***	*(0.07)*	0.667***	*(0.07)*	0.675***	*(0.07)*
Common colonial past	0.042	*(0.09)*	0.051	*(0.09)*	0.048	*(0.09)*	0.058	*(0.09)*	0.073	*(0.09)*	0.074	*(0.09)*
Geographical distance	-0.814***	*(0.03)*	-0.811***	*(0.03)*	-0.815***	*(0.03)*	-0.809***	*(0.03)*	-0.846***	*(0.03)*	-0.848***	*(0.03)*
EMU	1.413***	*(0.05)*	1.451***	*(0.06)*	1.423***	*(0.05)*	1.426***	*(0.06)*	1.344***	*(0.05)*	1.343***	*(0.05)*
NAFTA	-0.434	*(0.27)*	-0.450*	*(0.27)*	-0.478*	*(0.27)*	-0.439	*(0.27)*	-0.558**	*(0.26)*	-0.557**	*(0.26)*
MERCOSUR	1.351***	*(0.28)*	1.361***	*(0.27)*	1.119***	*(0.25)*	1.295***	*(0.27)*	1.390***	*(0.27)*	1.404***	*(0.27)*
ASEAN	2.451***	*(0.18)*	2.493***	*(0.18)*	2.381***	*(0.18)*	2.488***	*(0.18)*	2.340***	*(0.18)*	2.334***	*(0.18)*
R-squared adjusted	0.5444		0.5427		0.5551		0.5439		0.5402		0.5389	
No. of observations	8431		8431		8431		8431		8431		8431	

Note: The dependent variable is the foreign bias. ***CR*** is the creditor rights index of Djankov et al. (2007), the strength of legal rights of the World Bank, the efficiency of debt enforcement of Djankov et al. (2008), the recovery rate of the World Bank's *Doing Business*, the rule of law index of the World Bank and the integrity of legal system of the EFW in columns (1)-(6), respectively. The estimation procedure is ordinary least squares with robust standard errors (in parentheses). The constant and time dummies are included, but not explicitly reported.
***, ** and * denote significance at one, five and ten percent, respectively.

Table 9: Does the difference between domestic and foreign creditor protections affect the foreign bias indirectly?

	Creditor rights index of Djankov et al. (2007)		*Strength of legal rights index*		*Efficiency of debt enforcement of Djankov et al. (2008)*		*Recovery rate (World Bank's Doing Business Report)*		*Rule of law*		*Integrity of legal system*	
	(1)		*(2)*		*(3)*		*(4)*		*(5)*		*(6)*	
CR_i (home)	**0.093*** **	***(0.03)***	**0.015**	***(0.02)***	**0.025*** **	***(0.002)***	**0.022*** **	***(0.002)***	**0.375*** **	***(0.08)***	**0.099*** **	***(0.03)***
CR_j (host)	**0.163*** **	***(0.03)***	**0.011**	***(0.02)***	**-0.007*** **	***(0.002)***	**-0.001**	***(0.002)***	**0.436*** **	***(0.08)***	**0.099*** **	***(0.03)***
$D * CR_i$ (home)	**0.358*** **	***(0.04)***	**0.074*** **	***(0.03)***	**-0.012*** **	***(0.002)***	**-0.006** **	***(0.002)***	**0.268*** **	***(0.08)***	**0.088*** **	***(0.03)***
$D * CR_j$ (host)	**-0.367*** **	***(0.05)***	**-0.080*** **	***(0.03)***	**0.012*** **	***(0.002)***	**0.007*** **	***(0.002)***	**-0.485*** **	***(0.07)***	**-0.124*** **	***(0.03)***
Home country-specific control variables												
Depth of credit information	-0.306***	*(0.02)*	-0.258***	*(0.02)*	-0.299***	*(0.02)*	-0.321***	*(0.02)*	-0.254***	*(0.02)*	-0.241***	*(0.02)*
Capital account liberalization	-0.052***	*(0.01)*	-0.023**	*(0.01)*	-0.016	*(0.01)*	-0.021**	*(0.01)*	-0.023**	*(0.01)*	-0.027***	*(0.01)*
GDP growth rate	0.012	*(0.36)*	0.103	*(0.36)*	0.188	*(0.35)*	0.067	*(0.35)*	0.198	*(0.36)*	-0.023	*(0.36)*
Sovereign stability	0.149***	*(0.01)*	0.166***	*(0.01)*	0.130***	*(0.01)*	0.124***	*(0.01)*	0.169***	*(0.01)*	0.201***	*(0.01)*
Developed dummy	1.242***	*(0.10)*	1.145***	*(0.10)*	0.606***	*(0.10)*	0.477***	*(0.11)*	1.120***	*(0.10)*	1.173***	*(0.10)*
Bond market development	2.190***	*(0.42)*	2.081***	*(0.45)*	3.737***	*(0.44)*	3.459***	*(0.44)*	2.390***	*(0.43)*	2.509***	*(0.44)*
Rule of law	0.338***	*(0.06)*	0.331***	*(0.07)*	0.276***	*(0.07)*	0.345***	*(0.07)*				
Host country-specific control variables												
Depth of credit information	-0.149***	*(0.02)*	-0.131***	*(0.02)*	-0.148***	*(0.02)*	-0.150***	*(0.02)*	-0.119***	*(0.02)*	-0.135***	*(0.02)*
Capital account liberalization	-0.084***	*(0.01)*	-0.083***	*(0.01)*	-0.076***	*(0.01)*	-0.077***	*(0.01)*	-0.081***	*(0.01)*	-0.082***	*(0.01)*
GDP growth rate	1.445***	*(0.31)*	1.356***	*(0.32)*	1.501***	*(0.31)*	1.429***	*(0.31)*	1.074***	*(0.32)*	1.119***	*(0.32)*
Sovereign stability	0.027**	*(0.01)*	0.037***	*(0.01)*	0.021*	*(0.01)*	0.022**	*(0.01)*	0.030***	*(0.01)*	0.038***	*(0.01)*
Developed dummy	-0.069	*(0.08)*	-0.164*	*(0.09)*	-0.147*	*(0.09)*	-0.197**	*(0.09)*	-0.062	*(0.09)*	-0.058	*(0.08)*
Bond market development	9.412***	*(0.53)*	9.883***	*(0.54)*	10.219***	*(0.54)*	10.067***	*(0.53)*	9.789***	*(0.52)*	10.103***	*(0.53)*
Rule of law	0.207***	*(0.05)*	0.232***	*(0.06)*	0.188***	*(0.06)*	0.194***	*(0.05)*				

Table 9 (continued): Does the difference between domestic and foreign creditor protections affect the foreign bias indirectly?

	Creditor rights index of Djankov et al. (2007) (1)		*Strength of legal rights index* (2)		*Efficiency of debt enforcement of Djankov et al. (2008)* (3)		*Recovery rate (World Bank's Doing Business Report)* (4)		*Rule of law* (5)		*Integrity of legal system* (6)	
Bilateral effects												
Return correlation	-0.900***	*(0.10)*	-0.925***	*(0.11)*	-0.919***	*(0.10)*	-0.957***	*(0.10)*	-0.884***	*(0.11)*	-0.992***	*(0.11)*
Common legal origin	0.434***	*(0.05)*	0.460***	*(0.05)*	0.369***	*(0.05)*	0.400***	*(0.05)*	0.445***	*(0.05)*	0.383***	*(0.05)*
Common border	-0.209**	*(0.08)*	-0.247***	*(0.08)*	-0.153*	*(0.08)*	-0.240***	*(0.09)*	-0.246***	*(0.09)*	-0.229***	*(0.09)*
Common language	0.571***	*(0.07)*	0.627***	*(0.08)*	0.609***	*(0.08)*	0.633***	*(0.07)*	0.659***	*(0.07)*	0.702***	*(0.07)*
Common colonial past	0.161*	*(0.09)*	0.088	*(0.09)*	0.049	*(0.09)*	0.087	*(0.09)*	0.050	*(0.09)*	0.013	*(0.09)*
Geographical distance	-0.807***	*(0.03)*	-0.813***	*(0.03)*	-0.809***	*(0.03)*	-0.823***	*(0.03)*	-0.821***	*(0.03)*	-0.812***	*(0.03)*
EMU	1.471***	*(0.06)*	1.455***	*(0.06)*	1.502***	*(0.06)*	1.490***	*(0.06)*	1.401***	*(0.06)*	1.404***	*(0.05)*
NAFTA	0.171	*(0.26)*	-0.398	*(0.27)*	-0.769***	*(0.26)*	-0.679***	*(0.26)*	-0.499**	*(0.25)*	-0.522**	*(0.26)*
MERCOSUR	1.577***	*(0.28)*	1.411***	*(0.27)*	1.075***	*(0.26)*	1.156***	*(0.26)*	1.532***	*(0.28)*	1.608***	*(0.27)*
ASEAN	2.331***	*(0.17)*	2.443***	*(0.18)*	2.405***	*(0.19)*	2.482***	*(0.18)*	2.652***	*(0.17)*	2.561***	*(0.18)*
R-squared adjusted	0.5559		0.5439		0.5553		0.5528		0.5454		0.5423	
No. of observations	8431		8431		8431		8431		8431		8431	

Note: The dependent variable is the foreign bias displayed by 36 investing countries over the 2004-2012 period based on Eq. (9). Different proxies for creditor protection are used in columns (1)-(6) as $\boldsymbol{CR_i}$ and $\boldsymbol{CR_j}$.

The estimation procedure is ordinary least squares with robust standard errors and time dummies that account for time effects. The constant and time dummies are included, but not explicitly reported. Standard errors are reported in parentheses.

Impact of Culture and Patriotism on Home Bias in Bond Portfolios

An abridged version is published in Review of Managerial Science, 10, 256-301 (DOI: 10.1007/s11846-014-0146-4).

Elina Pradkhan

Humboldt University of Berlin
Institute of Finance
elina.pradkhan@hu-berlin.de

Abstract

Extant research has documented a substantial impact of culture and patriotism on equity home bias. This paper examines whether culture and patriotism influence home bias in bond portfolios. In this respect, I differentiate between two different aspects of home bias: domestic bias (overinvestment in domestic debt securities) and foreign bias (over- or underinvestment in debt securities issued by different host countries). The analysis uses the Coordinated Portfolio Investment Survey data over the 2004-2012 period and relies on extensive robustness checks based on four internationally recognized cross-cultural research projects: the GLOBE study of House et al. (2004), the "Cultures and Organizations" of Hofstede et al. (2010), the International Social Survey Program and the World Values Survey. There is strong evidence that patriotism deters foreign investment and increases overinvestment in domestic bonds. Investors from countries with higher levels of uncertainty avoidance invest less in foreign debt markets.

JEL Classification: G02, G11, G15

Keywords: home bias, international diversification, patriotism, culture, bonds.

Acknowledgements: I thank the anonymous reviewers for helpful comments and suggestions.

1 Introduction

According to the international version of the Capital Asset Pricing Model of Sharpe (1964) and Lintner (1965), all investors should hold the world market portfolio of risky assets. Instead, home bias in different asset classes is observed: Investors allocate a larger share of their portfolios to domestic equities and bonds than justified by the weights in the world market capitalization. This paper explores whether patriotism, cultural distance, individualism and uncertainty avoidance contribute to the explanation of the home bias phenomenon in bond markets. In the empirical analysis of the impact of culture and patriotism on international diversification in bond portfolios, this study distinguishes two aspects of home bias: the domestic bias that designates the relative overweighting of domestic bonds and the foreign bias that describes the relative underweighting or overweighting of foreign debt securities.

In the world of behavioral finance, culture and patriotism are assumed to influence preferences and behavior of individual investors and, thus, are important determinants of the financial decision making. Patriotic investors derive additional utility from investing in domestic securities. Cultural differences between countries imply a lower degree of familiarity. Uncertainty avoidance is associated with intolerance of ambiguity. Individualism is related to overconfidence. Several studies confirm that culture and patriotism impact home bias in equities (Beugelsdijk and Frijns, 2010; Anderson et al., 2011; Morse and Shive, 2011).

These results cannot be a priori extended to bond markets that differ from equity markets in several aspects such as a lower trading activity in secondary bond markets or a limited participation of individual investors that constitute the investor group that is supposed to be most affected by behavioral heuristics. However, an asset-invariant impact of culture and patriotism on investment decisions cannot be ruled out. There is no apparent reason why patriotic loyalty should manifest itself only with regard to stocks and not other types of tradable securities.[1] Moreover, the intolerance of ambiguity, overconfidence and familiarity (i.e. the behavioral underpinnings of the examined cultural variables) are not asset-specific behavioral determinants and culture is shown to affect the portfolio investment decisions of not only individual, but also institutional investors (e.g. Beugelsdijk and Frijns, 2010; Anderson et al., 2011). This study examines whether the documented importance of culture and patriotism for the explanation of equity home bias can be extended to home bias in bond markets, and, thus, indirectly explores whether patriotism and cultural characteristics of the home country are asset-invariant home bias drivers that determine allocations to both debt and equity securities.

[1] For instance, governments frequently appeal to the patriotic feeling of citizens to promote sovereign debt issuances. The "Patriot Bonds" issued by the US government to finance the anti-terrorism efforts are one example of a successful patriotic promotion of sovereign bonds (Morse and Shive, 2011).

Empirical analysis confirms that patriotism and uncertainty avoidance of the home country play an important role in the explanation of the home bias in bonds. Patriotism fosters overinvestment in domestic debt securities and increases underinvestment in foreign debt markets. Societies characterized by higher uncertainty avoidance display a lower preference for foreign debt securities. The obtained results are robust to various regression specifications. In addition to the cultural dimensions derived by Hofstede et al. (2010), I incorporate cultural dimensions of the GLOBE study of House et al. (2004). Following Morse and Shive (2011), the patriotism proxies are derived based on two different social surveys, the World Values Survey and the International Social Survey Program.

This paper is structured as follows. Section 2 briefly summarizes the existing literature on culture, patriotism and home bias. Section 3 describes the data used and the methodology applied to derive bond bias levels and proxies for culture and patriotism. Section 4 presents estimation results. Section 5 concludes.

2 Related Literature

In general, contrary to a vast literature on equity home bias, studies on home bias in bonds are rather scarce, and, to my knowledge, none of them incorporates either cultural aspects or patriotism in the empirical examination of domestic and foreign bond bias levels. Most existing studies on home bias in bonds focus on neoclassical factors such as financial liberalization, real exchange rate risk, investor protection, economic and financial market development as well as traditional familiarity proxies such as common border, common language and geographical distance (Fidora et al., 2007; Ferreira and Miguel, 2011). De Moor and Vanpée (2013) investigate the differences in the determinants of home bias in bond and equity portfolios. As expected, they find that public debt issues, sovereign bond ratings and bank credit supply determine the home bias in bonds, but not the home bias in equities. Apart from familiarity, behavioral explanations of home bias in bond markets have received little attention. One of the few studies that address behavioral aspects is that of Solnik and Zuo (2014) who show that, although relative optimism exerts an economically significant impact on domestic bias in bond and equity markets, the economic importance of optimism is lower for bonds compared to equities. Moreover, the relative optimism in bond markets is characterized by a higher time-series variation than the relative optimism in equity markets that is more persistent over time (Solnik and Zuo, 2014).

The economic impact of cultural characteristics has been examined e.g. in the context of syndicated loan markets (Giannetti and Yafeh, 2012), national preferences for bank-based versus market-based financing (Kwok and Tadesse, 2006; Aggarwal and Goodell, 2009), life

insurance consumption (Chui and Kwok, 2008), trading volume and momentum profits (Chui et al., 2010), investor rights protection (Stulz and Williamson, 2003), cross-border acquisition performance (Morosini et al., 1998), international trade and investment (Guiso et al., 2009), return smoothing behavior of hedge funds (Kang et al., 2015) and trading frequency (Beracha et al., 2015). Studies that examine the impact of culture on portfolio allocation decisions focus either on equity home bias or on international debt and equity portfolios, but not directly on domestic and foreign bias in bonds. Beugelsdijk and Frijns (2010) examine the impact of uncertainty avoidance, individualism and cultural distance on the foreign bias in the mutual fund equity holdings of developed countries in 1999 and 2000. They differentiate between developed and emerging host countries and find that uncertainty avoidance exerts a stronger impact on investment in equities issued in emerging markets, whereas cultural distance between host and home countries matters only for investment in equities issued in developed countries. Individualism significantly increases international diversification in both developed and emerging host markets (Beugelsdijk and Frijns, 2010).

Anderson et al. (2011) extend the set of cultural variables of Beugelsdijk and Frijns (2010) in order to account for the influence of long-term orientation and masculinity on domestic and foreign bias in equity holdings of institutional investors as of 2006. They show that cultural distance and uncertainty avoidance increase the domestic bias levels, whereas masculinity and long-term orientation reduce the overinvestment in domestic equities and increase international diversification. With respect to foreign bias and cultural distance, their results confirm the major findings of Beugelsdijk and Frijns (2010): Investment funds are more likely to underweight equities of those host countries that are more culturally distant from the home country. The impact of individualism on domestic bias is negative, but not robust across different specifications. As far as the relationship between individualism and the foreign bias is concerned, the results are not compatible with the evidence of Beugelsdijk and Frijns (2010). According to Beugelsdijk and Frijns (2010), more individualistic societies are less likely to underweight foreign equities in their portfolios. By contrast, Anderson et al. (2011) show that individualism increases underinvestment in foreign equities.

Aggarwal et al. (2012) investigate the impact of individualism, masculinity, power distance and uncertainty avoidance on cross-country bond and equity foreign portfolio investment positions. They show that cultural proximity and the three cultural dimensions of Hofstede (2001) - individualism, masculinity and power distance of both host and home countries - have a positive and significant impact on cross-country bond and equity foreign portfolio investment. Individualism, masculinity and power distance of host countries increase cross-border debt and equity holdings by similar amounts. By contrast, home country-specific cultural characteristics

exert different impacts on cross-border debt and equity holdings: Whereas individualism of the home country has a stronger impact on cross-border equity investment, the impact of masculinity is more pronounced for the cross-border debt investment. Uncertainty avoidance of either home or host countries does not significantly influence cross-border debt and equity holdings (Aggarwal et al., 2012).

One potential drawback of the study of Aggarwal et al. (2012) is that cross-border debt and equity holdings are absolute values measured in million USD. Absolute values allow no conclusions about the actual weights of cross-country holdings in debt and equity portfolios of investing countries. Moreover, Aggarwal et al. (2012) do not account for the fact that host countries with higher market capitalizations of their debt and equity markets attract more foreign investment. Thus, their results on cross-border debt portfolio holdings cannot be a priori extended to home bias that measures the deviation of the actual portfolio weight from the optimal portfolio weight, i.e. the under- and overinvestment in domestic and foreign debt securities.

Several studies suggest that patriotism may be an important determinant of investor behavior. Benartzi (2001) and Cohen (2009) document a strong tendency among employees to invest their discretionary benefits into their employer's stocks. Benos and Jochec (2013) show that patriotic sentiment can affect stock returns and that investors may be subconsciously driven towards stocks with patriotic names at times when patriotic sentiment is especially high, e.g. during wartime. Morse and Shive (2011) examine the relationship between patriotism and different domestic bias measures in equity markets. They document a positive and economically significant impact of patriotism on the overinvestment in domestic equities.

This paper examines the impact of uncertainty avoidance, individualism and cultural distance on home bias in bonds and, thus, contributes to the existing research of Beugelsdijk and Frijns (2010), Anderson et al. (2011) and Aggarwal et al. (2012) who focus on the impact of culture on home bias in equities and absolute values of foreign portfolio investment positions. Furthermore, following the research of Morse and Shive (2011) on patriotism and domestic equity bias, I fill a gap by studying the impact of patriotism on domestic and foreign bias in bond portfolios.

3 Data and Methodology

3.1 Domestic and Foreign Bias

The empirical analysis is based on debt portfolios of 40 countries (24 developed and 16 developing countries) over the 2004-2012 period. Following Fidora et al. (2007), the term

"bonds" is used to account for both short- and long-term debt securities. I distinguish between two different aspects of home bias: domestic and foreign bias (Chan et al., 2005). The domestic bias describes how strongly domestic investors overweigh domestic bonds compared to an optimal benchmark, whereas the foreign bias (also referred to as the bilateral home bias in the existing literature) reflects the degree to which domestic investors overweigh or underweight the bonds of a particular host country in their debt portfolios.

Following Chan et al. (2005), domestic bias of a country i is calculated in the following way:

$$DBIAS_i = \ln(w_i) - \ln(w_i^*) \quad (1).$$

w_i designates the actual debt portfolio weight allocated to domestic debt securities by investors from country i, whereas w_i^* represents the weight of domestic bonds in the world debt market capitalization. The higher the domestic bias $DBIAS_i$ is, the more market participants overinvest in domestic bonds. Given that all countries invest more in domestic debt securities than justified by their weights in the world market capitalization, domestic bias $DBIAS_i$ takes only positive values. Table 1 reports the actual and optimal portfolio weights allocated to domestic debt securities, w_i and w_i^*, as well as the domestic bond bias levels of the sample countries. The lowest domestic bias level is observed in the United States. Developed countries and members of the European Monetary Union (with the exception of Greece) display lower domestic bias levels compared to developing countries where overinvestment in domestic debt securities is more pronounced.

Following Chan et al. (2005), foreign bias $FBIAS_{i,j}$ displayed by the investors from home country i with regard to the debt securities of the host country j is computed as:

$$FBIAS_{i,j} = \ln(w_{i,j}) - \ln(w_j^*) \quad (2).$$

$w_{i,j}$ corresponds to the actual fraction of the country i's total debt portfolio that investors domiciled in country i allocate to debt securities issued by residents in host country j. Following the existing literature, the optimal benchmark according to the International Capital Asset Pricing Model, w_j^*, is computed as the weight of the host country j' debt securities in the world debt market portfolio (e.g. Fidora et al., 2007). Negative values of the foreign bias measure $FBIAS_{i,j}$ reflect a bias against foreign debt securities, i.e. the underinvestment in foreign debt securities. If the actual and optimal portfolio weights are equal ($w_j^* = w_{i,j}$), the foreign bias measure takes the value of zero. Positive values of the foreign bias indicate a bias towards debt securities issued by residents in host country j, i.e. investors overinvest in the debt securities of

the host country compared to the optimal benchmark. Table 1 shows the equally weighted average foreign bias that a country i displays towards $n-1$ sample host countries:

$$\overline{FBIAS_i} = \frac{\sum_{j=1, j\neq i}^{n} FBIAS_{i,j}}{n-1} \quad (3).$$

On average, every country i underinvests in the debt securities issued in other sample countries $j \neq i$, i.e. the average foreign bias $\overline{FBIAS_i}$ is negative in every country. However, when individual target countries are considered, underinvestment (i.e. negative foreign bias values: $FBIAS_{i,j} < 0$) is not always observed. For instance, the EMU countries predominantly display positive foreign bias $FBIAS_{i,j}$ with respect to other EMU countries, i.e. they overinvest in debt securities issued in other EMU countries. In addition, investors appear to overinvest in debt securities issued in those host countries that are geographically or culturally closer. For instance, Austrian investors display positive foreign bias levels towards debt securities issued in the Czech Republic and Hungary. Similarly, Scandinavian countries invest more in each others' debt securities than would be warranted by the weights in the world debt market portfolio.

Bond market capitalizations are collected from the Total Debt Securities Statistics published by the Bank for International Settlements (BIS). For those countries that are not included in the Total Debt Securities Statistics, bond market capitalizations are calculated as the sum of the amounts outstanding of international and domestic debt securities issued by residents, compiled by combining the Domestic and International Debt Securities Statistics of the BIS. The data on the cross-border investment are taken from the Coordinated Portfolio Investment Survey (CPIS) of the International Monetary Fund that provides the data on cross-country debt holdings for 80 countries over the 1997-2012 period. However, the survey does not report domestic debt holdings. Following Fidora et al. (2007), domestic debt holdings are approximated by the difference between the home country i's debt market capitalization and the sum of the portfolio holdings of the home country i's debt securities by the remaining reporting 79 countries. The underlying assumption is that non-reporting countries do not invest in bonds issued in country i (Fidora et al., 2007). The country i's total holdings of foreign bonds are approximated by the total value of foreign investment as reported by the CPIS. Thus, the total debt portfolio is computed as the sum of the derived domestic debt holdings and the total value of foreign debt investment as reported by the CPIS.

3.2 Culture and Patriotism

Culture is defined by Hofstede (2001) as "the collective programming of the mind that distinguishes members of one group or category of people from another" (Hofstede, 2001, p. 9). Hofstede (2001) identifies four cultural dimensions (power distance, masculinity, individualism

and uncertainty avoidance) that are derived based on a survey of the IBM employees conducted during the 1967-1973 period. Hofstede et al. (2010) add further cultural dimensions, long-term-orientation and indulgence, that are derived based on the 1995-2004 and 2005-2008 World Values Survey (WVS) data.

The GLOBE study of House et al. (2004) distinguishes nine cultural dimensions (uncertainty avoidance, power distance, gender egalitarianism, in-group collectivism, institutional collectivism, assertiveness, humane orientation, performance orientation and future orientation) and is derived based on a broader industrial setting (financial services, food processing and telecommunications). Contrary to the research design of Hofstede et al. (2010), the GLOBE study targets only managerial employees. The self-report questionnaires were collected during the time interval between 1994 and 1997. House et al. (2004) differentiate between cultural practices and cultural values: Cultural values are supposed to reflect ideology and the values that should prevail in a society, whereas cultural practices are assumed to describe the actual state of the world, namely the values that currently prevail in the society according to the perception of survey participants. Hofstede (2006) questions the respondents' ability to correctly assess the values that currently determine their societies. For reasons of consistency, this study deals only with the cultural value dimensions of the GLOBE study of House et al. (2004).

The existing literature that examines the impact of culture on investment behavior relates cultural dimensions to unobservable psychological attributes. Cultural proximity is commonly associated with familiarity (Anderson et al., 2011; Beugelsdijk and Frijns, 2010), uncertainty avoidance is related to ambiguity aversion (Hofstede, 2001), whereas individualism is assumed to reflect overconfidence (Chui et al., 2010; Anderson et al., 2011). A clear-cut distinction between cultural aspects and the corresponding behavioral patterns is difficult. However, the existing studies find that the impact of culture goes beyond traditional behavioral proxies (e.g. Beugelsdijk and Frijns, 2010). From a variety of cultural dimensions identified by Hofstede et al. (2010) and House et al. (2004) I choose uncertainty avoidance and individualism for two reasons. First, these cultural dimensions reflect behavioral aspects that are relevant to portfolio allocation decisions. Second, their definition and measurement are consistent across different studies.

Uncertainty avoidance

The uncertainty avoidance dimension characterizes societies that shun ambiguous situations and strive to minimize the probability of unpredictable future events (Hofstede et al., 2010; House et al., 2004). Importantly, uncertainty avoidance is not merely a reflection of risk aversion that would imply that investors avoid highly risky securities independently of whether these

securities are the domestic or the foreign ones.[2] By contrast, Hofstede (2001) argues that uncertainty avoidance is related more to intolerance of ambiguity than to risk avoidance and that uncertainty avoidance affects solely the tendency to take unknown risks, not risks in general. In this respect, foreign securities are more likely to be the source of unknown risks than the domestic ones. It is the risk type that is central to the uncertainty avoidance concept: If uncertainty avoidance is high, only known risks (such as driving fast) are taken, whereas low levels of uncertainty avoidance imply that taking unknown risks (such as changing employers) is equally acceptable (Hofstede, 2001).

Furnham and Ribchester (1995) argue that one of the primary characteristics of ambiguity intolerance is the preference for the familiar and the rejection of the different or unusual. Similarly, Heath and Tversky (2001) define aversion to ambiguity as a preference for betting on chance events the probabilities of which are known and well defined. Boyle et al. (2012) complement the classic Markowitz model by introducing ambiguity aversion that results in a preference for familiar securities. Thus, investors from cultures characterized by high uncertainty avoidance should react more strongly to information asymmetries and familiarity. Their preference for domestic and, hence, more familiar debt securities as well as the unwillingness to invest in less known foreign securities should be more pronounced as compared to societies with lower scores for uncertainty avoidance. As a consequence, I expect a positive relationship between uncertainty avoidance and overinvestment in domestic debt securities (domestic bias). By contrast, high uncertainty avoidance should reduce investment in foreign debt securities and, thus, exert a negative impact on the foreign bias.

As shown in Tables 1 and 2, countries with the highest uncertainty avoidance scores of Hofstede et al. (2010) such as Portugal and Greece range among the countries with the highest domestic bias levels. By contrast, Spain and Japan are among the countries with the highest uncertainty avoidance scores, but display comparatively low domestic bond bias levels. Whereas the correlation between uncertainty avoidance of the GLOBE study and domestic bias amounts to 0.58, the correlation between uncertainty avoidance of Hofstede et al. (2010) with domestic bias is close to zero and insignificant (Table 3).

Individualism

As opposed to collectivism, Hofstede et al. (2010) relate individualism to the importance of individual rights and independence. The GLOBE study of House et al. (2004) distinguishes two

[2] If uncertainty avoidance reflected only risk aversion, its impact on domestic bias would be ambiguous. It would, indeed, be positive for investors from home countries with less risky bonds. By contrast, an investor located in a country with comparatively risky bonds would be unwilling to invest much of his wealth in domestic bonds and, instead, reduce risk by international diversification. In this case, the impact of uncertainty avoidance on domestic bias would be negative.

aspects of the individualism-collectivism dimension. Institutional collectivism describes the degree to which institutional practices and economic system encourage collective action and group loyalty. In-group collectivism designates the importance of collective actions and interdependence within families. Both collectivism dimensions are positively correlated. Given that low collectivism scores reflect high individualism, the correlations of the collectivism dimensions of the GLOBE study with the individualism of Hofstede et al. (2010) are negative. This study uses institutional collectivism instead of in-group collectivism since institutional collectivism displays the strongest negative correlation with the individualism score of Hofstede et al. (2010) for the chosen sample countries.

Chui et al. (2010) relate the individualism of Hofstede et al. (2010) to overconfidence: In societies characterized by higher individualism, decisions are made by individuals and not by groups and, therefore, are more likely to be driven by overconfidence. Similarly, Markus and Kitayama (1991) argue that the view of an individual as an independent and autonomous entity coincides with the self-favorability bias that results in an overestimation of one's skills and abilities. Odean (1998) and Van den Steen (2004) argue that overconfident individuals overestimate their abilities and the precision of their knowledge.

With respect to the impact of individualism and the associated overconfidence on international diversification, there are two conflicting strands of opinion in the existing literature. Studies that test the impact of individualism on home bias in equities postulate that overconfidence induces a lower risk perception with regard to the foreign investment. Thus, overconfidence is supposed to boost foreign investment and should result in greater international diversification (higher foreign bias) and lower domestic bias levels (Anderson et al., 2011; Beugelsdijk and Frijns, 2010). Visual inspection of the data lends some support to this argument: The US and UK are countries with the highest (lowest) individualism (collectivism) scores and display the lowest degree of overinvestment in domestic debt securities. In addition, domestic bond bias is very high in countries such as Colombia, Greece and Indonesia that range among countries with the lowest individualism (and highest institutional collectivism) scores. The correlation between domestic bond bias and individualism is, as expected, negative and amounts to -0.59 (Table 3).

By contrast, the link between the institutional collectivism and the overinvestment in domestic bonds appears to be rather weak: The correlation bears the expected positive sign, but is insignificant and amounts to merely 0.23 (Table 3). While there is indeed a strong positive link between overconfidence and risk taking, the empirical and theoretical literature also relates overconfidence to more concentrated and less diversified portfolios (e.g. Goetzmann and Kumar, 2008; Odean, 1998). In this case, we should expect a positive (negative) relationship

between domestic bias and individualism (collectivism of the GLOBE study) and a negative (positive) relationship between individualism (collectivism) and foreign bias.

Cultural distance

In the context of syndicated loan markets, Giannetti and Yafeh (2012) identify two channels through which cultural distance may influence individual portfolio decisions: information asymmetries and transaction costs. First, they argue that cultural differences exacerbate the intensity of information asymmetries and the resulting agency problems. Hence, cultural distance should enhance the perceived riskiness of foreign bonds. Second, Giannetti and Yafeh (2012) point out that cultural distance may also reflect institutional differences related to legal systems and contracting terms that increase the cost of information gathering and, thus, further reduce the attractiveness of foreign investment. Finally, investors perceive host countries that are culturally similar to their home countries as more familiar (Huberman, 2001; Grinblatt and Keloharju, 2001). A number of control variables for institutional similarities, information asymmetries and familiarity (such as common language, common border, geographical distance and common legal origin) are used in order to examine whether cultural distance has an impact that goes beyond institutional proximity, information asymmetries and familiarity considerations.

The cultural distance $CD_{i,j}$ between the home country i and the host country j is measured in the following way:

$$CD_{i,j} = \frac{\sum_{n=1}^{N}\left(\frac{\|C_{n,i}-C_{n,j}\|}{v_n}\right)}{N} \quad (4).$$

$C_{n,i}$ corresponds to the nth cultural dimension of the country i. v_n denotes the standard deviation of the nth cultural dimension. $CD_{i,j}^{Hofstede}$ is compounded based on four cultural dimensions $(N = 4)$[3] of Hofstede et al. (2010), and $v_n^{Hofstede}$ is computed based on 76 countries. By contrast, $CD_{i,j}^{GLOBE}$ incorporates nine cultural value dimensions $(N = 9)$ derived by the GLOBE study of House et al. (2004), and v_n^{GLOBE} is calculated based on 59 countries. For domestic bias regressions, cultural distance is computed as the average cultural distance to the rest of the world, $\overline{CD}_i$. The "rest of the world" is approximated by 75 countries for the cultural distance based on Hofstede et al. (2010) and 58 countries for the cultural distance computed based on the GLOBE study of House et al. (2004).

[3] These dimensions are power distance, masculinity, individualism and uncertainty avoidance. Indulgence and long-term orientation are not included since these scores are not available for several countries in my sample.

Tables 1 and 2 report the domestic bias levels and the average cultural distances based on cultural dimensions of Hofstede et al. (2010) and the GLOBE study. A visual inspection of the data does not confirm the hypothesis that countries that are more culturally distant from the rest of the world display higher domestic bond bias levels. Although the correlation between the two average cultural distance measures is positive, both proxies for cultural distance are negatively, but not significantly correlated with domestic bond bias (Table 3). For instance, Japan is one of the countries that are the most culturally distant from other countries and, still, it displays the second lowest domestic bias level among the sample countries.

Patriotism

Shimp and Sharma (1987) introduce the concept of consumer ethnocentrism that describes the behavior of a consumer who questions the appropriateness and morality of purchasing foreign products. They argue that, albeit a separate concept, consumer ethnocentrism is closely related to patriotism. Morse and Shive (2011) elaborate on further channels through which patriotism may affect consumer and investor choices: Either patriotic loyalty induces investors to believe that domestic financial products are superior to the foreign ones, or investors purchase domestic products in spite of being aware of their sub-optimality inasmuch as they derive additional utility from supporting the domestic economy.

One proxy for patriotism is calculated based on the World Values Survey (WVS). Given that the 2005 WVS does not encompass all sample countries, for Israel, the Philippines and Singapore the 2000 WVS is used, and the patriotism proxies for Czech Republic and Hungary are computed based on the 1995 WVS. Following Morse and Shive (2011), I concentrate on one particular question as a proxy for patriotism: "How proud are you to be (substitute nationality)?". I assign to the possible answers "very proud", "quite proud", "not very proud" and "not at all proud" discrete numbers ranging from four to one, respectively, and compute the country averages. Another patriotism score that is used as a robustness check is derived based on the 2003 National Identity Survey of the International Social Survey Program (ISSP). The answers to the question "I would rather be a citizen of this country" range from "agree strongly" and "agree" to "neither agree or disagree", "disagree" and "disagree completely". These answers are assigned the numerical values from five to one, respectively.

Both the WVS and ISSP patriotism proxies are constructed in such a way that higher scores correspond to a higher patriotism displayed by the home country. The correlation between these two patriotism proxies amounts to 0.58 for the sample countries and is highly significant (Table 3). Given that patriotism is assumed to shift preferences towards domestic assets, it should reduce international diversification and increase overinvestment in domestic assets. Hence, a

positive (negative) relationship between patriotism and domestic (foreign) bond bias is expected.

A visual inspection of the data indicates a link between domestic bias and the WVS patriotism. For instance, Colombia and Philippines display the highest WVS patriotism and range among the countries with the highest domestic bias levels. In addition, Japan is the country with one of the lowest WVS patriotism scores and is characterized by the lowest domestic bias. By contrast, the positive relationship between the ISSP patriotism and the domestic bias is less evident. For instance, the US is assigned the highest ISSP patriotism score, but displays the lowest domestic bond bias. Indeed, whereas the correlation between the ISSP patriotism and domestic bias is comparatively low and statistically insignificant, it amounts to 0.45 for the WVS patriotism and domestic bond bias (Table 3).

3.3 Methodology

In order to identify the determinants of domestic bias, the following model is used:

$$DBIAS_i = f(FC_i, CV_i, Uncertainty_i, Individualism_i, Patriotism_i, \overline{CD}_i) \quad (5).$$

Domestic bias $DBIAS_i$ is the function of uncertainty avoidance, individualism and patriotism scores assigned to the home country i as well as the average cultural distance $\overline{CD}_i$ between the home country i and the rest of the world. The dummy variable FC_i takes the value of one if the home country is one of the large financial centers (Hong Kong, Ireland, Japan, Singapore, Switzerland, UK and US). Investment in bonds does not only depend on culture and patriotism, but is also affected by familiarity, institutional proximity, information asymmetries as well as economic and institutional characteristics of the home country. These factors are captured by the home country-specific control variables CV_i.

A visual inspection of the data suggests a link between domestic bias and patriotism, individualism, uncertainty avoidance and cultural distance. However, the correlation between these variables and overinvestment in domestic bonds may simply reflect economic and institutional characteristics of the home country. Culture and patriotism may impact investment decisions not directly, but through their influence on legal and institutional environment. Therefore, the following home country-specific characteristics are included as control variables CV_i: banking system stability, sovereign stability, bond market development, creditor protection, capital account liberalization, GDP per capita growth rate, average geographical distance to the rest of the world, GDP per capita growth rate correlation with the world GDP per capita growth rate, a dummy variable that takes the value of one if the home country is a member of the EMU or regional trade agreements such as NAFTA/MERCOSUR/ASEAN as well as the number of

countries that have a common border/language with the home country. The more detailed descriptions of control variables and the used databases are summarized in Table 4.

Given a high number of explanatory variables, variance inflation factors (VIFs) are used in order to ensure that multicollinearity problems do not arise. The VIF of a regressor measures by how much the variance of the coefficient estimate increases due to the non-orthogonality of independent variables compared to the situation in which the regressor is orthogonal to other independent variables. According to a rule of thumb, VIFs of ten or higher indicate severe multicollinearity (e.g. Hill and Adkins, 2001). I adopt a more conservative approach: The maximum acceptable value that the VIFs are allowed to take is five for the variables of interest (cultural distance, individualism, uncertainty avoidance and patriotism).

As one of the robustness checks, I substitute the domestic bias by the actual portfolio weight assigned to domestic bonds, w_i, and use the optimal portfolio weight, i.e. the weight of domestic bond market capitalization in the world bond market capitalization, w_i^*, as one of the explanatory variables:

$$w_i = f(FC_i, w_i^*, CV_i, Uncertainty_i, Individualism_i, Patriotism_i, \overline{CD_i}) \quad (6).$$

The idea behind this procedure is that culture and patriotism may affect not only the actual portfolio weights allocated to domestic debt securities, w_i, but also the domestic debt market capitalization that constitutes the benchmark w_i^* against which the overinvestment is measured. Culture influences the structure of markets and institutions (Kwok and Tadesse, 2006; Aggarwal and Goodell, 2009). Corporate governance practices may be also determined by cultural variables (Stulz and Williamson, 2003). Similarly, Hofstede (2001), House et al. (2004) and Morse and Shive (2001) argue that culture may influence economic and institutional development. Thus, an impact of culture on the bond market development of the home country and on the home country's weight in the world debt market capitalization w_i^* cannot be ruled out. Domestic bias is computed as the log ratio of the actual to the optimal portfolio weight of domestic securities. In this case, even if culture and patriotism significantly affect the actual portfolio allocations, the impact of culture on domestic bond bias that captures the deviation of the actual portfolio allocation from the optimal benchmark may sum up to zero. Eq. (6) accounts for the fact that cultural characteristics and patriotism of the home country may influence only the actual allocations to domestic bonds, but not the domestic bias.

In order to evaluate the impact of culture and patriotism on the foreign bond bias $FBIAS_{i,j}$, the following model is used:

$$FBIAS_{i,j} = f(FC_i, DBIAS_i, CV_j, CV_{i,j}, Uncertainty_i, Individualism_i, Patriotism_i, CD_{i,j}) \quad (7).$$

Following Chan et al. (2005), Beugelsdijk and Frijns (2010) and Ferreira and Miguel (2011), I include the level of domestic bias of the home country, $DBIAS_i$, as one of the explanatory variables. It accounts for the automatic impact of domestic bias on the foreign bias. The higher the overinvestment in domestic debt securities is, the lower is the fraction of debt portfolio that can be invested in foreign debt securities. Once the absolute level of domestic bias is included in the regression specification related to the foreign bias, home country-specific variables are not considered (Chan et al., 2005; Beugelsdijk and Frijns, 2010; Ferreira and Miguel, 2011).

CV_j is the vector of control variables that are supposed to reflect the host country-specific characteristics: bond market development, sovereign stability, banking system development, creditor rights protection, GDP per capita growth rate, capital account liberalization and a dummy variable that takes the value of one if the host country is a developed country. $CV_{i,j}$ designates control variables that account for familiarity, institutional proximity and information asymmetries: geographical distance between the capitals of home and host countries, dummy variables that take the value of one if host and home countries have a common border, common language or common legal origin, and regional dummies that take the value of one if both the host and the home country are members of the EMU, NAFTA, ASEAN or MERCOSUR. Furthermore, I include bond market return correlations that are supposed to reflect potential diversification benefits. $CD_{i,j}$ is the cultural distance between the home country i and the host country j computed based on Eq. (4). $Uncertainty_i$, $Individualism_i$ and $Patriotism_i$ are uncertainty avoidance, individualism and patriotism scores assigned to the home country i.

As a robustness check, I substitute the foreign bias by the actual portfolio weight assigned by residents in the home country i to the debt securities issued by residents in the host country j, $w_{i,j}$. The optimal portfolio weight, i.e. the weight of the host country j's debt securities in the world debt market capitalization w_j^*, is included as an additional explanatory variable:

$$w_{i,j} = f(FC_i, w_j^*, DBIAS_i, CV_j, CV_{i,j}, Uncertainty_i, Individualism_i, Patriotism_i, CD_{i,j}) \quad (8).$$

Ferreira and Miguel (2011) argue that the inclusion of financial centers may distort the estimation results. Sample countries such as Hong Kong, Ireland, Japan, Singapore, Switzerland, UK and US attract and invest foreign funds from all over the world and, therefore, display comparatively low domestic bias levels. In every regression specification, I include a dummy variable FC_i that takes the value of one if the home country is one of the above mentioned financial centers. Ferreira and Miguel (2011) split the sample into financial and non-financial centers. However, splitting the sample into financial and non-financial centers is problematic for two reasons. First, a separate estimation for financial centers would have

resulted in a very low number of observations for domestic bias regressions. Second, the results for the foreign bias regressions that incorporate only financial centers as home countries are strongly affected by multicollinearity: Variance inflation factors associated with patriotism and individualism are above 40 and, therefore, exceed the maximum acceptable threshold levels of five. Therefore, as a robustness check, I estimate the base models (Eq. (5) and (7)) for non-financial centers only.

In the empirical analysis of the determinants of home bias levels, Ferreira and Miguel (2011) apply ordinary least squares (OLS) estimations with time-fixed effects. Fidora et al. (2007) estimate a pure cross-section with averaged data for home bias levels over the 2001-2003 period. Whereas the consideration of the average home bias levels fails to incorporate information contained in the time dimension, the OLS estimations with time-fixed effects neglect cross-sectional information. The incorporation of both time-series and cross-sectional information based on the standard panel data techniques is not possible given that both the Hausman and Sargan-Hansen tests reject the null hypothesis of the validity of the random effects model.[4] However, the fixed effects model does not permit estimating the coefficients on the time-invariant variables of interest: patriotism, uncertainty avoidance, individualism and cultural distance. Similarly, it is not possible to account for home country-fixed effects due to the time-invariability of cultural variables. Therefore, this study follows Ferreira and Miguel (2011) and examines the impact of culture and patriotism on home bias in bonds by means of the OLS estimations with dummy variables that account for time effects. This procedure is applied to both the domestic and foreign bias estimations that are based on yearly observations over the 2004-2012 period. As a robustness check, a pure cross-section based on the data averaged over the 2004-2012 sample period is estimated for the foreign bias regressions.[5]

4 Results

4.1 Domestic Bias

In columns (1)-(4) of Table 5, the WVS patriotism and the cultural variables of Hofstede et al. (2010) are included one by one. Columns (4)-(7) report the results based on Eq. (5) where all four variables of interest are included as independent variables in the same regression. Columns (4) and (6) combine the cultural variables of Hofstede et al. (2010) and the GLOBE study with the WVS patriotism scores. The WVS patriotism is substituted by the ISSP patriotism in columns (5) and (7). There is strong evidence that patriotism increases overinvestment in domestic debt securities. By contrast, the negative and significant coefficient estimate on the

[4] Results on the Hausman and Sargan-Hansen tests are available on demand.
[5] A comparable cross-sectional test for domestic bias is not possible due to a low number of sample countries: It would result in a regression model with 15 regressors and only 39 observations.

uncertainty avoidance of Hofstede et al. (2010) is not compatible with the prediction that societies characterized by high uncertainty avoidance display higher domestic bias levels (columns (2)-(5) of Table 5). The high statistical significance of the coefficient estimate on the Hofstede's uncertainty avoidance is not compatible with the insignificant, close to zero correlation between domestic bias and uncertainty avoidance either (Panel A in Table 3). Although highly statistically significant, the economic significance of Hofstede's uncertainty avoidance is negligible: A ten point increase in the corresponding cultural variable measured on a scale from one to 120 corresponds to a decline in domestic bias by 0.1-0.2. By contrast, the GLOBE uncertainty avoidance has the expected positive and highly significant impact on domestic bias in bonds (columns (6) and (7) of Table 5).

There is little evidence that the preference for domestic bonds is significantly affected by individualism and that cultural distance to the rest of the world increases the domestic bias. The individualism of Hofstede et al. (2010) is not significant in either specification (columns (3)-(5) of Table 5), and the sign on the institutional collectivism of the GLOBE study changes depending on the patriotism proxy used (columns (6) and (7) of Table 5). Similarly, cultural distance computed based on the cultural dimensions of Hofstede et al. (2010) is either not significant or bears the counterintuitive negative sign (columns (4) and (5) of Table 5). By contrast, the cultural distance based on the cultural dimensions of the GLOBE study appears to have a positive effect on the preference for domestic bonds (columns (6) and (7) of Table 5).

Table 6 reports the estimation results for the sample that excludes the major financial centers (Hong Kong, Ireland, Japan, Singapore, Switzerland, UK and US). In columns (1)-(4), different combinations of the cultural variables of Hofstede et al. (2010) and the GLOBE study with the WVS and ISSP patriotism are considered. The coefficients on both the WVS and ISSP patriotism are positive and highly significant in the regression specifications that involve the cultural variables of Hofstede et al. (2010). The uncertainty avoidance scores of Hofstede et al. (2010) and the GLOBE study exert the predicted positive impact on domestic bond bias only in conjunction with the WVS patriotism (columns (1) and (3) of Table 6). The GLOBE institutional collectivism is significant in only one regression specification and its impact on domestic bias is negative (column (3) of Table 6). Similarly, the positive impact of the individualism of Hofstede et al. (2010) on domestic bond bias is significant in only one regression specification (column (2) of Table 6). The coefficient estimate on cultural distance has the expected positive and significant sign in two of four regression specifications (columns (1) and (3) of Table 6).

As an additional robustness check, domestic bias as dependent variable is replaced by the actual portfolio weight allocated to domestic debt securities according to Eq. (6). Table 7 summarizes

the estimation results. There is strong evidence that patriotic loyalty shifts investor preferences towards domestic assets and, as a consequence, increases domestic bias. The patriotism variable is positive and highly significant in three of four regression specifications (columns (1)-(3) of Table 7). The economic significance is substantial: One point increase in the WVS (ISSP) patriotism measured on a scale from one to four (five) raises the portfolio share allocated to domestic debt securities by 13.1 to 15.6 percent. Similarly, uncertainty avoidance significantly increases the portfolio shares allocated to domestic debt securities in three of four regression specifications (columns (1), (3) and (4) of Table 7). Moreover, there is evidence that individualism (institutional collectivism) impacts positively (negatively) the preference for domestic bonds. The evidence on cultural distance is less robust: Only cultural distance computed based on the GLOBE cultural dimensions increases significantly the investment in domestic bonds (columns (3) and (4) of Table 7).

All in all, culture and patriotism significantly contribute to the explanation of the domestic bias phenomenon: The Wald tests reject the null hypothesis of the restricted model (a model without cultural variables and patriotism) at one percent significance level in practically all regression specifications. Nonetheless, only for patriotism, there is robust evidence of a significant impact on domestic bias: Patriotic loyalty shifts investor preferences towards domestic assets and, as a consequence, increases domestic bias. The economic importance of patriotism is substantial. One point increase in the WVS (ISSP) patriotism measured on a scale from one to four (five) triggers an increase in domestic bias by up to 0.8 and raises the actual portfolio fraction invested in domestic debt securities by up to 15.6 percent.

For the cultural distance and individual cultural variables (individualism and uncertainty avoidance), the estimation results are less robust. There is some evidence that cultural distance to the rest of the world increases the overinvestment in domestic debt securities, but this evidence is not very robust across different regression specifications: The impact of the home country's cultural distance to the rest of the world on the domestic bias is positive and significant only in half of all regression specifications. The individualism of Hofstede et al. (2010) is significant only in three regression specifications where its impact on domestic bond bias is positive: The positive impact is not consistent with the prediction that high overconfidence associated with this cultural dimension reduces the overinvestment in domestic bonds. Albeit highly significant in most regression specifications, the direction of the impact of institutional collectivism is rather unstable across different regression specifications. The coefficient estimates on uncertainty avoidance are significant in a majority of regression specifications, but have the expected positive sign only in seven out of 13 specifications. It is the GLOBE uncertainty avoidance for which there is most robust evidence of a positive and

significant relationship between domestic bias and uncertainty avoidance. By contrast, although the uncertainty avoidance scores of the GLOBE study and Hofstede et al. (2010) are closely interrelated,[6] there is only weak evidence of a comparable positive impact of the uncertainty avoidance of Hofstede et al. (2010).

The economic significance of the GLOBE cultural variables is more pronounced compared to the cultural variables of Hofstede et al. (2010). For instance, one point increase in the GLOBE collectivism (the opposite of individualism that is measured on a scale from one to seven) results in a decline of domestic bias by 0.42-1.22 and reduces the actual portfolio weight of domestic bonds by 9.8-16 percent. By contrast, a ten point increase in the individualism of Hofstede et al. (2010) that is measured on a scale from one to 120 increases domestic bias only by 0.12 and the portfolio weights allocated to domestic bonds by 1.33-1.73 percent.[7] Furthermore, whereas one point increase in the uncertainty avoidance score of the GLOBE study raises the portfolio fraction assigned to domestic debt securities by 7.4-22.4 percent and triggers an increase in domestic bias by 0.29-0.74, a ten point increase in the uncertainty avoidance of Hofstede et al. (2010) increases in the portfolio share assigned to domestic bonds by merely 2.1 percent and the domestic bias by only 0.07.

For individualism and uncertainty avoidance, the results for regressions where the actual portfolio weight assigned to domestic bonds is used as dependent variable (Table 7) are more robust than in regression specifications with the domestic bias as dependent variable (Tables 5 and 6). One potential explanation is that cultural characteristics of the home country impact not only the actual portfolio allocations to domestic bonds, w_i, but also the development and, thus, the capitalization of the domestic bond market, w_i^*. As a consequence, the impact of individual cultural characteristics on the domestic bias that measures the discrepancy between w_i and w_i^* may be less pronounced. The instability of the coefficient estimates on individualism, uncertainty avoidance and cultural distance in the regression specifications related to domestic bias may also be due to collinearity. Correlations between patriotism and cultural variables and of cultural variables with each other are considerable (Table 3). However, a harmful multicollinearity can be ruled out since neither variance inflation factor for the variables of interest (culture and patriotism) exceeds the critical value of five in any regression specification.

The impact of control variables is mostly consistent with expectations. Financial centers and countries with more developed bond markets attract more foreign investment due to higher liquidity and lower transaction costs and are characterized by lower domestic bias levels and

[6] The correlation between the uncertainty avoidance scores of Hofstede et al. (2010) and the GLOBE study amounts to 0.34 for the sample countries.
[7] The impact of the individualism scores of Hofstede et al. (2010) on domestic bond bias is substantially lower compared to the results of Anderson et al. (2011) for domestic equity bias.

lower portfolio weights assigned to domestic bonds. A more efficient protection of creditor rights enhances the attractiveness of domestic bonds and induces higher domestic bias levels. Average geographical distance to the rest of the world that is associated with lower familiarity and a higher degree of information asymmetries exerts a positive and highly significant impact on domestic bias and portfolio shares allocated to domestic debt securities.

4.2 Foreign Bias

Table 8 reports the estimation results based on Eq. (7) for different combinations of cultural variables of the GLOBE study and Hofstede et al. (2010) with the WVS and ISSP patriotism scores. In columns (1)-(4), the WVS patriotism and cultural variables of Hofstede et al. (2010) are included one by one. In column (5), the ISSP patriotism is combined with the cultural variables of Hofstede et al. (2010), whereas in columns (6) and (7) the cultural variables of the GLOBE study are included together with the WVS and ISSP patriotism proxies, respectively. Patriotism and uncertainty avoidance exert a negative and highly significant impact on the foreign bias in bonds in practically all regression specifications.[8] Individualism of Hofstede et al. (2010) is significant only in conjunction with the ISSP patriotism (column (5) of Table 8), whereas the sign on the institutional collectivism of the GLOBE study changes with the patriotism proxy used (columns (6) and (7) of Table 8). Cultural distance computed based on the cultural dimensions of Hofstede et al. (2010) positively and significantly impacts the foreign bias, whereas the GLOBE cultural distance is not significant. The positive sign on the cultural distance does not support the hypothesis that cultural distance is associated with more pronounced information asymmetries and that lower familiarity deters the foreign investment.

As one of the robustness checks, financial centers are excluded from the total sample (Table 9). Patriotism is significant in two of four regression specifications (columns (3) and (4) of Table 9). The negative sign is consistent with the prediction that patriotic loyalty decreases the cross-border investment. The results on individualism are the same as for the total sample. The coefficient estimate on the cultural distance based on the cultural dimensions of Hofstede et al. (2010) is significant, but it bears a counterintuitive positive sign that is not consistent with the hypothesis that cultural distance between investing and destination countries impedes the cross-border investment.

[8] Columns (4) and (6) of Table 2 show that the coefficient estimate on the WVS patriotism looses more than half of its value when the GLOBE cultural variables instead of the cultural variables of Hofstede et al. (2010) are used. One potential explanation may be collinearity: Table 3 shows that cultural distance, uncertainty avoidance and institutional collectivism of the GLOBE study are more strongly correlated with the WVS patriotism than the corresponding cultural variables of Hofstede et al. (2010).

As a next step, Eq. (7) is estimated for a simple cross-section with dependent and explanatory variables averaged over the sample period from 2004 to 2012. The results are reported in Table 10. In this case, the WVS and ISSP patriotism proxies are significant only in conjunction with the cultural variables of Hofstede et al. (2010). Coefficients on uncertainty avoidance are negative and significant in all four regression specifications, whereas cultural distance is not significant in any regression specification. The evidence on individualism/ institutional collectivism remains vague: The sign on institutional collectivism depends on the patriotism proxy used, and the individualism of Hofstede et al. (2010) is negative and significant only combined with the ISSP patriotism.

As the last robustness check, Table 11 reports the estimation results for Eq. (8) that substitutes the foreign bias by the actual debt portfolio weights allocated to different host countries. For patriotism and uncertainty avoidance, there is very robust evidence that foreign investment is lower for investing countries characterized by high patriotism and high uncertainty avoidance (columns (1)-(4) of Table 11). Only when the individualism of Hofstede et al. (2010) is considered, there is evidence that more individualistic societies are less likely to invest in foreign bonds (columns (1) and (2) of Table 11). The coefficient estimates on cultural distance are not significant in either regression specification.

All in all, although the null hypothesis of a restricted model (a model without cultural variables and patriotism) is rejected at one percent significance level in all regression specifications, there is robust evidence of a significant and unambiguous impact on the foreign bias only for patriotism and uncertainty avoidance. The coefficient estimates on patriotism are negative and significant in most specifications. One point increase in the WVS patriotism, measured on a scale from one to four, is associated with a decline in foreign bias by up to 1.02 and lowers the actual portfolio fraction of foreign debt securities by up to 0.54 percent. Compared to the foreign bias, the impact of patriotism on the actual portfolio weights allocated to foreign debt securities appears to be rather modest. Nonetheless, it is substantial since the actual portfolio weights assigned to foreign debt securities amount on average to merely 0.66 percent. Given that lower values of the foreign bias are associated with a higher degree of underinvestment in foreign securities, the results confirm the hypothesis that patriotism induces a bias against foreign assets.

Similarly, there is strong evidence that uncertainty avoidance negatively impacts the foreign bias, i.e. countries characterized by high levels of uncertainty avoidance display a higher degree of underinvestment in foreign debt securities. Columns (1) and (2) of Table 8 show that adding uncertainty avoidance to the regression specification with patriotism increases the adjusted R-squared from 0.37 to 0.45. The coefficient estimates on uncertainty avoidance are negative and

highly significant in most specifications and the economic impact is considerable. Increase by one point in the uncertainty avoidance of the GLOBE study that is measured on a scale from one to seven reduces the foreign bias by 0.79-1.37 points and the actual portfolio fraction of foreign debt securities by up to 0.46 percent. The economic significance of the uncertainty avoidance of Hofstede et al. (2010) is lower. A ten percent increase in the uncertainty avoidance score of Hofstede et al. (2010) that is measured on a scale from one to 120 triggers a decline in the foreign bias by up to 0.38 points and reduces the actual portfolio weights of foreign debt securities by 0.1 percent.[9] The magnitude of the uncertainty avoidance coefficient in the foreign bond bias regressions is comparable to the impact of uncertainty avoidance on the foreign equity bias as documented by Beugeldijk and Frijns (2010).

There is no evidence that cultural distance between host and home countries reduces international diversification (foreign bias). Coefficient estimates on cultural distance are, if significant, positive. However, the positive sign is not compatible with the hypothesis that cultural distance increases underinvestment in foreign debt securities. In a majority of specifications, cultural distance is not significant. The absence of a significant relationship between cultural distance and foreign bond investment is not consistent with the evidence of Giannetti and Yafeh (2012) for syndicated loan markets. Giannetti and Yafeh (2012) document that cultural differences between the countries of the syndicate's lead bank and the borrower determine the contract terms. One possible explanation may be that cultural differences are closely related to information asymmetries and that syndicated loans require a more intense interaction between contracting parties such that information asymmetries are more important compared to the issuance and purchase of standardized debt securities.

There is only weak and contradictory evidence that individualism/institutional collectivism impact significantly the foreign investment in bond markets. If significant, the negative sign on individualism of Hofstede et al. (2010) is consistent with the evidence of Odean (1998) and Goetzmann and Kumar (2008) who argue that overconfidence (the behavioral underpinning of individualism) results in more concentrated and less diversified portfolios. With respect to the institutional collectivism of the GLOBE study, there is a great instability in the sign of the coefficient estimate: It is negative (positive) in conjunction with the WVS (ISSP) patriotism. One reason may be collinearity. However, neither variance inflation factor for the variables of interest (culture and patriotism) exceeds the critical value of five in any regression specification such that a harmful collinearity should not be a problem. Moreover, the correlations of the institutional collectivism with the WVS and ISSP patriotism are not very high (Panel B of Table 3). The instability of coefficient estimates may be due to different samples used: Since the ISSP

[9] Given that the sample mean of the actual portfolio weight amounts to 0.66 percent, the economic impact of uncertainty avoidance on the actual portfolio weight is still considerable.

patriotism proxy is not available for all sample countries, the samples related to the ISSP patriotism exclude a wide range of countries such as Argentina, Brazil, Colombia, Greece, Hong Kong, India, Indonesia, Italy, Malaysia, Mexico, Singapore, Thailand and Turkey.

The coefficient estimates on control variables are consistent with the existing literature on the foreign bias. High domestic bias levels are associated with lower foreign bias levels, i.e. lower international diversification. Financial centers display higher foreign bias levels, i.e. they are less likely to underweight foreign debt securities in their portfolios. Bond market development of the host country fosters international diversification and increases foreign bias in bonds. Developed countries are more diversified and attract more foreign investment. Traditional proxies for familiarity and information asymmetries such as common legal origin, common language as well as geographical distance are also highly significant and have the expected impact on the foreign bias in bonds. Common EMU membership that is associated with deep financial integration and abolition of the real exchange rate risk increases foreign bias and, thus, has a positive effect on the diversification across foreign markets.

5 Conclusion

Although ideology per se cannot be considered as the only determinant of behavior, values that prevail in a society are important guidelines that influence behavioral patterns and investment decisions. Patriotism induces a strong preference for domestic goods, uncertainty avoidance is associated with intolerance of ambiguity that enhances the perceived risk of foreign securities, and individualism is linked to overconfidence. This paper contributes to the existing literature on international asset allocation by exploring the impact of culture and patriotism on home bias in bonds. It relies on four internationally recognized cross-cultural research projects, "Cultures and Organizations" of Hofstede et al. (2010), the GLOBE study of House et al. (2004), the International Social Survey Program and the World Values Survey. Two different aspects of home bias are considered: the domestic bias that measures the degree of overinvestment in domestic debt securities and the foreign bias that reflects the cross-country under- or overinvestment in foreign debt securities relative to the market capitalization weights.

With respect to individualism, the existing studies on home bias in equities arrive at contradictory results: Beugelsdijk and Frijns (2010) show that individualism increases allocations to foreign stocks, whereas Anderson et al. (2011) find a negative impact of individualism on international diversification (foreign bias) in equity markets. This study finds that more individualistic societies display a stronger preference for domestic debt securities and underinvest more in foreign debt markets, but this evidence is not very robust. Solnik and Zuo (2014) show that relative optimism, which is closely related to overconfidence, is less stable in

bond than in equity markets. If overconfidence is strongly affected by time-series variation, the time-invariant individualism of Hofstede et al. (2010) and collectivism of the GLOBE study may not fully capture the overconfidence dimension. This may partially explain the absence of any robust impact of individualism and institutional collectivism on home bias in bonds.

Contrary to the studies on equity bias (Beugelsdijk and Frijns 2010; Anderson et al. 2011), this study does not find any robust evidence that cultural distance increases either overinvestment in domestic debt securities or underinvestment in foreign debt securities. One potential explanation may be the role of information asymmetries. Perceived information advantages are one of the behavioral underpinnings of cultural distance that is associated with higher information asymmetries and a lower degree of familiarity. Compared to equities, debt securities are less subject to the unknown and unfamiliar: The expected payoff of a fixed claim is less sensitive to information asymmetries than the expected payoff of a residual claim and the relevant information on sovereign bonds that make up a substantial part of the total bond market is available and easy to follow. The results on cultural distance are consistent with the evidence of Portes et al. (2001) who show that the impact of geographical distance on the US residents' foreign transactions is higher for equities than for bonds.

This study confirms the importance of patriotism as one of the explanations of the cross-country variation in the domestic and foreign bond bias levels. There is strong evidence that societies characterized by higher patriotism display higher domestic bias levels and a stronger bias against foreign debt securities. Moreover, contrary to Aggarwal et al. (2012) who do not find any significant impact of uncertainty avoidance on cross-border debt investment, this study finds strong evidence that uncertainty avoidance reduces investment in foreign debt securities resulting in a lower foreign bias, i.e. lower international diversification. The impact of uncertainty avoidance on the foreign bias in bonds is comparable to its impact on the foreign equity bias as documented by Beugelsdijk and Frjins (2010). However, the evidence of a positive relationship between uncertainty avoidance and domestic bond bias is less convincing: The expected positive and significant impact of uncertainty avoidance on the overinvestment in domestic bonds is observed only in slightly more than half of all regression specifications.

All in all, the obtained evidence that patriotism and uncertainty avoidance substantially reduce international diversification in debt portfolios is an indication that behavioral and cultural aspects improve the understanding of the home bias puzzle. Future research may focus on the impact of cultural and behavioral aspects on the home bias in debt portfolios held by different investor types. In particular, the differentiation between the home bias levels exhibited by private and institutional investors may provide additional insight on whether culture and patriotism impact the debt portfolio allocations of different investor types in the same way.

References

Aggarwal, R., Goodel, J.W. (2009). Markets and institutions in financial intermediation: National characteristics as determinants. Journal of Banking and Finance, 33, 1770-1780.

Aggarwal, R., Kearney, C., Lucey, B. (2012). Gravity and culture in foreign portfolio investment. Journal of Banking and Finance, 36, 525-538.

Anderson, C.W., Fedenia, M., Hirschey, M., Skiba, H. (2011). Cultural influences on home bias and international diversification by institutional investors. Journal of Banking and Finance, 35, 916-934.

Benartzi, S. (2001). Excessive extrapolation and the allocation of 401(k) accounts to company stock. The Journal of Finance, 56, 1747-1764.

Benos, E., Jochec, M. (2013). Patriotic name bias and stock returns. Journal of Financial Markets, 16, 550-570.

Beracha, E., Fedenia, M., Skiba, H. (2014). Culture's impact on institutional investors' trading frequency. International Review of Financial Analysis, 31, 34-47.

Beugelsdijk, S., Frijns, B. (2010). A cultural explanation of the foreign bias in international asset allocation. Journal of Banking and Finance, 34, 2121-2131.

Boyle, P., Garlappi, L., Uppal, R., Wang, T. (2012). Keynes meets Markowitz: the trade-off between familiarity and diversification. Management Science, 58, 253-272.

Chan, K., Covrig, V., Ng, L. (2005). What determines the domestic bias and foreign bias? Evidence from mutual fund equity allocations worldwide. The Journal of Finance, 60, 1495-1534.

Chui, A., Kwok, C. (2008). National culture and life insurance consumption. Journal of International Business Studies, 39, 88-101.

Chui, A., Titman, S., Wei, J. (2010). Individualism and momentum around the world. The Journal of Finance, 65, 361-392.

Cohen, L. (2009). Loyalty-based portfolio choice. Review of Financial Studies, 22, 1213–1245.

De Moor, L., Vanpée, R. (2013). What drives international equity and bond holdings? An empirical study. Applied Financial Economics, 23, 1067-1082.

Ferreira, M.A., Miguel, A.F. (2011). The determinants of domestic and foreign bond bias. Journal of Multinational Financial Management, 21, 279-300.

Fidora, M., Fratzscher, M., Thimann, C. (2007). Home bias in global bond and equity markets: The role of real exchange rate volatility. Journal of International Money and Finance, 26, 631-655.

Furnham, A., Ribchester, T. (1995). Tolerance of ambiguity: A review of the concept, its measurement and applications. Current Psychology, 14, 179-199.

Giannetti, M., Laeven, L. (2012). The flight home effect: Evidence from the syndicated loan market during financial crises. Journal of Financial Economics, 104, 23-43.

Giannetti, M., Yafeh, Y. (2012). Do cultural differences between contracting parties matter? Evidence from syndicated bank loans. Management Science, 58, 365-383.

Goetzmann, W.N., Kumar, A. (2008) Equity portfolio diversification. Review of Finance, 12, 433-463.

Grinblatt, M., Keloharju, M. (2001). How distance, language, and culture influence stockholdings and trades. The Journal of Finance, 56, 1053-1073.

Guiso, L., Sapienza, P., Zingales, L. (2009). Cultural biases in economic exchange? The Quarterly Journal of Economics, 124, 1095-1131.

Gwartney, J., Lawson, R., Hall, J. (2013). 2013 economic freedom dataset. Economic Freedom of the World: 2013 Annual Report, Fraser Institute.

Heath, C., Tversky, A. (1991). Preference and belief: Ambiguity and competence in choice under uncertainty. Journal of Risk and Uncertainty, 4, 5-28.

Hill, R.C., Adkins, L.C. (2001). Collinearity. In: Baltagi B.H. (Ed.). A Companion to Theoretical Econometrics, Blackwell, Oxford, Chapter 12.

Hofstede, G. (2001). Culture's consequences: comparing values, behaviors, institutions and organizations across nations, 2nd edn. Sage Publications Inc, Thousand Oaks, CA.

Hofstede, G. (2006). What did GLOBE really measure? Researchers' minds versus respondents' minds. Journal of International Business Studies, 37, 882-896.

Hofstede, G., Hofstede, G.J., Minkov, M. (2010). Cultures and organizations: Software of the mind, 3rd edn. New York: McGraw-Hill USA.

House, R.J., Hanges, P.J., Javidan, M., Dorfman, P.W., Gupta, V. (2004). Culture, leadership, and organizations: the GLOBE study of 62 societies. Sage Publications, Thousand Oaks, CA.

Huberman, G. (2001). Familiarity breeds investment. The Review of Financial Studies, 14, 659-680.

Kang, B.U., Kim, T.S., Oh, D.J. (2015). National culture and the return manipulation of hedge funds. EFMA Working Paper. Accessed May 2015, available at: http://www.efmaefm.org/0EFMAMEETINGS/EFMA%20ANNUAL%20MEETINGS/2015-Amsterdam/papers/EFMA2015_0393_fullpaper.pdf.

Kwok, C., Tadesse, S. (2006). National culture and financial systems. Journal of International Business Studies, 37, 227-247.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A. (2008). The economic consequences of legal origins. Journal of Economic Literature, 46, 285-332.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., Vishny, R.W. (1997). Legal determinants of external finance. The Journal of Finance, 52, 1131-1150.

Lintner, J. (1965). The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. The Review of Economics and Statistics, 47, 13-37.

Markus, H.R., Kitayama, S. (1991). Culture and the self: implications for cognition, emotion, and motivation. Psychological Review, 98, 224-253.

Morosini, P., Shane, S., Singh, H. (1998). National cultural distance and cross-border acquisition performance. Journal of International Business Studies, 29, 137-158.

Morse, A., Shive, S. (2011). Patriotism in your portfolio. Journal of Financial Markets, 14, 411-440.

Odean, T. (1998). Volume, volatility, price, and profit when all traders are above average. The Journal of Finance, 53, 1887-1934.

Portes, R., Rey, H., Oh, Y. (2001). Information and capital flows: the determinants of transactions in financial assets. European Economic Review, 45, 783-796.

Sharpe, W.F. (1964). Capital asset prices: a theory of market equilibrium under conditions of risk. The Journal of Finance, 19, 425-442.

Shimp, T.A., Sharma, S. (1987). Consumer ethnocentrism: construction and validation of the CETSCALE. Journal of Marketing Research, 24, 280-289.

Solnik, B., Zuo, L. (2014). Relative optimism and the home bias puzzle. SSRN Working Paper. Accessed June 2014, available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2398737.

Stulz, R.M., Williamson, R. (2003). Culture, openness, and finance. Journal of Financial Economics, 70, 313-349.

Van den Steen, E. (2004). Rational overoptimism (and other biases). The American Economic Review, 94, 1141-1151.

Appendix

Table 1: Domestic and foreign bond bias levels

Home Country	Actual Portfolio Weight of Domestic Bonds (2012)	Optimal Portfolio Weight of Domestic Bonds (2012)	Domestic Bias (2012)	Average Foreign Bias $\overline{FBIAS_i}$ (2012)	Actual Portfolio Weight of Domestic Bonds (2004-2012 average)	Optimal Portfolio Weight of Domestic Bonds (2004-2012 average)	Domestic Bias (2004-2012 average)	Average Foreign Bias $\overline{FBIAS_i}$ (2004-2012 average)
Argentina	93.68	0.15	6.41	-4.12	93.56	0.19	6.23	-5.93
Australia	86.66	2.11	3.71	-2.81	87.70	1.69	3.96	-3.03
Austria	55.79	0.67	4.42	-1.22	51.92	0.75	4.23	-1.16
Belgium	49.07	0.77	4.15	-2.45	42.62	0.78	4.00	-2.17
Brazil	99.56	2.4	3.72	-8.64	99.30	1.83	4.03	-7.90
Canada	88.68	2.2	3.70	-3.28	89.39	2.03	3.79	-3.34
Chile	82.03	0.18	6.14	-3.21	80.87	0.14	6.38	-3.16
Colombia	91.31	0.13	6.56	-4.48	89.75	0.10	6.80	-4.30
Czech Republic	87.04	0.14	6.41	-3.69	83.30	0.12	6.54	-2.76
Denmark	77.33	0.96	4.39	-4.78	80.25	1.03	4.36	-1.79
Finland	35.91	0.3	4.80	-1.82	41.35	0.27	5.02	-0.98
France	59.07	4.75	2.52	-1.78	54.66	4.67	2.46	-1.58
Germany	56.20	4.57	2.51	-1.16	63.41	5.73	2.41	-1.38
Greece	56.84	0.25	5.43	-3.68	58.68	0.44	4.88	-2.64
Hong Kong	37.01	0.27	4.91	-2.01	27.57	0.17	5.08	-1.30
Hungary	97.31	0.12	6.68	-4.86	97.59	0.13	6.61	-5.07
India	99.99	0.67	5.00	-10.24	99.41	0.20	6.71	-7.33
Indonesia	90.66	0.18	6.20	-5.77	95.98	0.14	6.55	-4.73
Ireland	30.32	1.26	3.18	-0.99	31.71	1.42	3.11	-1.08
Israel	86.92	0.24	5.87	-4.67	85.07	0.21	6.01	-4.13
Italy	83.47	4.08	3.02	-2.77	76.59	4.22	2.90	-2.55
Japan	83.32	15.3	1.70	-2.63	84.12	15.56	1.69	-2.54
Malaysia	94.24	0.4	5.47	-4.52	96.59	0.30	5.78	-4.13
Mexico	90.09	0.71	4.84	-5.67	94.60	0.58	5.10	-5.62
Netherlands	43.59	2.4	2.90	-0.70	45.19	2.51	2.89	-0.91
Norway	41.98	0.56	4.32	-0.74	41.11	0.44	4.54	-1.25
Philippines	92.94	0.14	6.53	-2.81	92.06	0.12	6.66	-2.40
Poland	98.04	0.33	5.68	-4.38	99.71	0.29	5.82	-3.32
Portugal	70.96	0.41	5.14	-1.51	47.07	0.37	4.81	-1.27
Russia	90.07	0.46	5.27	-4.91	83.80	0.30	5.72	-4.03
Singapore	38.27	0.31	4.82	-1.27	37.22	0.23	5.08	-0.70
South Africa	93.71	0.26	5.87	-4.10	95.70	0.22	6.06	-5.38
Spain	85.33	2.54	3.51	-2.20	67.60	2.35	3.35	-1.94
Sweden	69.87	0.81	4.45	-2.44	68.47	0.77	4.48	-2.42
Switzerland	18.31	0.24	4.32	-0.93	20.17	0.26	4.35	-1.12
Thailand	92.58	0.31	5.69	-3.66	94.62	0.23	6.06	-3.80
Turkey	99.47	0.31	5.76	-6.35	99.17	0.32	5.73	-6.28
UK	62.92	6.06	2.34	-1.03	61.14	5.93	2.34	-0.98
US	92.34	36.89	0.92	-2.42	93.56	39.17	0.87	-2.62

Note: The actual portfolio weights show the debt portfolio shares that 39 sample countries allocate to domestic debt securities. Optimal portfolio weights are computed as the fraction of the market capitalization of domestic bonds in the world debt market capitalization. Actual and optimal portfolio weights are reported in percentages. Domestic bias is computed as the log ratio of the actual portfolio weight to the optimal portfolio weight (Eq. (1)). The average foreign bias $\overline{FBIAS_i}$ is the equally weighted average foreign bias that a country i displays towards the sample host countries (Eq. (3)). Foreign bias is the log ratio of the actual portfolio weight allocated by the investors domiciled in home country i to the country j's debt securities to the weight of debt securities issued by residents in country j in the world debt market portfolio (Eq. (2)). 39 host countries are considered: countries listed in the first column of Table 1 as well as Peru. Columns 2-5 report the data as of 2012. Columns 6-9 report data averaged over the 2004-2012 sample period. The data are averaged over the 2008-2012 period for Chile, over the 2009-2012 period for Ireland and over the 2005-2012 period for Malaysia and Mexico.

Table 2: Culture and patriotism

	Hofstede average cultural distance	GLOBE average cultural distance	WVS patriotism	ISSP patriotism	Hofstede uncertainty avoidance	GLOBE uncertainty avoidance	Hofstede individualism	GLOBE institutional collectivism
Argentina	0.90	1.12	3.54	n/a	86	4.66	46	5.32
Australia	1.24	0.97	3.63	4.41	51	3.98	90	4.40
Austria	1.40	1.23	n/a	4.08	70	3.66	55	4.73
Belgium	1.04	n/a	n/a	n/a	94	n/a	75	n/a
Brazil	0.85	1.23	3.17	n/a	76	4.99	38	5.62
Canada	1.11	1.28	3.66	4.39	48	3.75	80	4.17
Chile	1.04	n/a	3.51	4.19	86	n/a	23	n/a
Colombia	1.01	n/a	3.88	n/a	80	4.98	13	5.38
Czech Republic	0.87	n/a	3.18	3.89	74	n/a	58	n/a
Denmark	1.72	1.30	n/a	4.24	23	3.82	74	4.19
Finland	1.16	1.23	3.49	4.28	59	3.85	63	4.11
France	0.98	1.03	3.14	3.75	86	4.26	71	4.86
Germany	1.06	1.12	2.85	3.43	65	3.63	67	4.75
Greece	1.12	1.09	n/a	n/a	112	5.09	35	5.40
Hong Kong	1.08	1.18	2.62	n/a	29	4.63	25	4.43
Hungary	1.36	0.88	3.39	4.31	82	4.66	80	4.50
India	1.01	0.97	3.68	n/a	40	4.73	48	4.71
Indonesia	1.05	1.10	3.38	n/a	48	5.23	14	5.18
Ireland	1.31	0.96	n/a	4.15	35	4.02	70	4.59
Israel	1.19	0.92	3.44	4.22	81	4.38	54	4.27
Italy	1.08	0.93	3.30	n/a	75	4.47	76	5.13
Japan	1.32	1.41	2.80	4.30	92	4.33	46	3.99
Malaysia	1.31	1.08	3.64	n/a	36	4.88	26	4.87
Mexico	1.05	1.00	3.77	n/a	82	5.26	30	4.92
Netherlands	1.39	1.37	3.07	3.26	53	3.24	80	4.55
Norway	1.45	n/a	3.42	3.84	50	n/a	69	n/a
Philippines	1.18	1.15	3.84	4.28	44	5.14	32	4.78
Poland	1.01	0.95	3.58	4.03	93	4.71	60	4.22
Portugal	1.15	1.08	n/a	4.10	104	4.43	27	5.30
Russia	1.19	1.13	3.25	3.93	95	5.07	39	3.89
Singapore	1.33	1.06	3.48	n/a	8	4.22	20	4.55
South Africa	1.00	0.99	3.73	4.10	49	4.76	65	4.34
Spain	0.89	0.99	3.53	3.85	86	4.76	51	5.20
Sweden	1.65	1.25	3.29	3.73	29	3.60	71	3.94
Switzerland	1.13	1.19	3.20	3.31	58	3.50	68	4.50
Thailand	0.97	1.20	3.84	n/a	64	5.61	20	5.10
Turkey	0.88	1.14	3.77	n/a	85	4.67	37	5.26
UK	1.37	1.00	3.44	4.01	35	4.11	89	4.31
US	1.25	1.03	3.58	4.56	46	4.00	91	4.17

Note: The table reports patriotism and cultural variables scores for 39 sample countries. Patriotism proxies are derived based on the World Values Survey (WVS) and International Social Survey Program (ISSP). Cultural variables are based on the cultural dimensions of Hofstede et al. (2010) and the GLOBE study of House et al. (2004). The Hofstede's scores for Belgium, Switzerland and South Africa are drawn from Hofstede's website: http://www.geert-Hofstede.com. Cultural distance is computed based on Eq. (4). The average cultural distance is calculated as the average cultural distance to the "rest of the world". The "rest of the world" is approximated by 75 countries for cultural distance based on Hofstede et al. (2010) and 58 countries for cultural distance computed based on the GLOBE study of House et al. (2004).

Table 3: Correlations between domestic bias, cultural dimensions and patriotism

Panel A: Domestic bias, patriotism and cultural variables of Hofstede et al. (2010)

	Domestic bias	WVS patriotism	ISSP patriotism	Cultural distance	Uncertainty avoidance	Individualism
Domestic bias	1					
WVS patriotism	0.45***	1				
ISSP patriotism	0.12	0.58***	1			
Cultural distance	-0.27	-0.16	0.07	1		
Uncertainty avoidance	0.08	-0.02	-0.03	-0.50***	1	
Individualism	-0.59***	-0.17	-0.03	0.36**	-0.16	1

Panel B: Domestic bias, patriotism and GLOBE cultural variables

	Domestic bias	WVS patriotism	ISSP patriotism	Cultural distance	Uncertainty avoidance	Collectivism
Domestic bias	1					
WVS patriotism	0.45***	1				
ISSP patriotism	0.12	0.58***	1			
Cultural distance	-0.20	-0.38*	-0.23	1		
Uncertainty avoidance	0.58***	0.42**	0.38*	0.32*	1	
Collectivism	0.23	0.25	-0.26	-0.15	0.50***	1

Note: The table shows correlations between the 2004-2012 average domestic bias, the WVS and ISSP patriotism measures and cultural value variables. The higher the domestic bias is, the higher is the overinvestment in domestic debt securities. Panel A contains cultural variables (average cultural distance to the rest of the world, uncertainty avoidance and individualism) of Hofstede et al. (2010). Panel B is based on cultural variables (average cultural distance to the rest of the world, uncertainty avoidance and collectivism) of the GLOBE study of House et al. (2004).
***, **, * denote significance at one, five and ten percent, respectively.

Table 4: Control variables for domestic and foreign bias regressions

Banking system stability is approximated by domestic credit provided by the banking sector (% of GDP). Source: World Development Indicators of the World Bank.
Bond market development is approximated by the ratio of international debt to the total international debt outstanding. Source: Bank for International Settlement.
Capital account liberalization is an index of capital restrictions based on the IMF data compiled by the Economic Freedom of the World Annual Report. A higher score corresponds to a lower level of capital controls. Source: Gwartney et al. (2013).
Common border is a dummy variable that takes the value of one if the host and home countries have a common border. For the regressions related to the domestic bias, it is computed as the number of countries that have a common border with the home country. Source: CEPII.
Common language is a dummy variable that takes the value of one if the host and home countries share the same official language. For domestic bias regressions, it is computed as the number of countries that have a common language with the home country. Source: CEPII.
Common legal origin is a dummy variable that takes the value of one if the host and home countries have the same legal origin. With respect to different legal origins, I distinguish between common law, French civil law, Scandinavian civil law and German civil law countries. Source: La Porta et al. (1997, 2008).
*C**reditor protection*** is the strength of legal rights index of the World Bank that assigns higher numbers to countries with more efficient collateral and bankruptcy laws. Source: World Development Indicators of the World Bank.
GDP per capita annual growth rate correlation is a proxy for international diversification benefits and is based on the correlation between the annual growth rate of the GDP per capita of the home country with the annual growth rate of the world GDP per capita over the 1990-2012 period. Source: World Development Indicators of the World Bank.
Geographical distance is the natural logarithm of the distance in kilometers between the capitals of the host and home countries. For domestic bias regressions, the average distance is computed as the natural logarithm of the average distance between the capitals of the home country and 224 potential host countries. Source: CEPII.
To account for the diversification potential, I compute ***return correlations*** between the JP Morgan GBI 1-10 years total return indices denominated in USD on a monthly basis over the 2000-2013 period. BofA Merrill Lynch 1-10 years total return indices (denominated in USD) are used for Norway and Switzerland. Source: Datastream.
Local currency sovereign credit ratings are converted to numerical values with higher numbers reflecting a higher ***sovereign stability***. Positive and negative credit outlooks are also accounted for. Source: Fitch Ratings.

Table 5: Determinants of domestic bias

	WVS patriotism (1)		WVS patriotism & Hofstede's uncertainty avoidance (2)		WVS patriotism & Hofstede's uncertainty avoidance & individualism (3)		Hofstede & WVS (4)		Hofstede & ISSP (5)		GLOBE & WVS (6)		GLOBE & ISSP (7)	
Patriotism	**0.693*** **	***(0.20)***	**0.826*** **	***(0.19)***	**0.811*** **	***(0.19)***	**0.790*** **	***(0.19)***	**0.534*** **	***(0.17)***	**0.383** **	***(0.19)***	**0.799*** **	***(0.15)***
Uncertainty avoidance			**-0.010*** **	***(0.00)***	**-0.009*** **	***(0.00)***	**-0.008*** **	***(0.00)***	**-0.021*** **	***(0.00)***	**0.610*** **	***(0.10)***	**0.292** **	***(0.12)***
Individualism/collectivism					**-0.004**	***(0.003)***	**-0.004**	***(0.003)***	**0.005**	***(0.01)***	**-0.415*** **	***(0.11)***	**0.347** **	***(0.16)***
Cultural distance							**0.294**	***(0.35)***	**-1.018*** **	***(0.28)***	**1.459*** **	***(0.42)***	**1.197*** **	***(0.26)***
Financial center dummy	-0.131	*(0.19)*	-0.056	*(0.18)*	-0.143	*(0.18)*	-0.129	*(0.19)*	-0.598***	*(0.21)*	-0.710***	*(0.21)*	-1.342***	*(0.19)*
Bond market development	-19.53***	*(1.29)*	-20.25***	*(1.19)*	-19.22***	*(1.48)*	-19.31***	*(1.48)*	-16.58***	*(1.61)*	-15.65***	*(1.26)*	-10.44***	*(1.11)*
Capital account liberalization	-0.036	*(0.02)*	-0.021	*(0.02)*	-0.022	*(0.02)*	-0.030	*(0.02)*	-0.032	*(0.03)*	-0.044**	*(0.02)*	-0.142***	*(0.02)*
Creditor protection	0.123***	*(0.03)*	0.095***	*(0.03)*	0.103***	*(0.03)*	0.095***	*(0.03)*	-0.025	*(0.04)*	0.184***	*(0.02)*	0.033	*(0.03)*
Banking system stability	-0.009***	*(0.00)*	-0.008***	*(0.00)*	-0.008***	*(0.00)*	-0.008***	*(0.00)*	-0.010***	*(0.00)*	-0.008***	*(0.00)*	-0.008***	*(0.00)*
GDP per capita growth	0.106	*(0.69)*	-0.068	*(0.66)*	-0.024	*(0.67)*	-0.079	*(0.67)*	-0.481	*(0.7)*	-0.097	*(0.63)*	-0.025	*(0.58)*
Sovereign stability	-0.098***	*(0.02)*	-0.106***	*(0.02)*	-0.108***	*(0.02)*	-0.105***	*(0.02)*	-0.158***	*(0.02)*	-0.118***	*(0.02)*	-0.210***	*(0.03)*
EMU/NAFTA/MERCOSUR/ ASEAN membership	-0.196	*(0.13)*	-0.194	*(0.12)*	-0.226*	*(0.13)*	-0.204	*(0.14)*	-0.616***	*(0.18)*	-0.290**	*(0.11)*	-1.346***	*(0.12)*
Common border	-0.086***	*(0.02)*	-0.059***	*(0.02)*	-0.063***	*(0.02)*	-0.059***	*(0.02)*	-0.089***	*(0.02)*	-0.098***	*(0.02)*	-0.154***	*(0.01)*
Common language	0.004**	*(0.00)*	0.002	*(0.00)*	0.002	*(0.00)*	0.003*	*(0.00)*	-0.001	*(0.00)*	0.006***	*(0.00)*	0.006***	*(0.00)*
Geographical distance	2.058***	*(0.33)*	-2.055***	*(0.30)*	-2.102***	*(0.30)*	2.170***	*(0.28)*	2.730***	*(0.51)*	2.736***	*(0.28)*	4.184***	*(0.36)*
GDP growth correlation with world GDP	-1.237***	*(0.29)*	-1.153***	*(0.28)*	-0.977***	*(0.30)*	-1.078***	*(0.34)*	-1.718**	*(0.70)*	-1.130***	*(0.27)*	0.753	*(0.50)*
No. of observations	276		276		276		276		201		252		186	
R-squared adjusted	0.8416		0.8496		0.8499		0.8498		0.8901		0.8794		0.9889	
Wald test for a restricted model (p-value)	12.43	*(0.000)*	15.78	*(0.000)*	10.77	*(0.000)*	7.98	*(0.000)*	5.96	*(0.000)*	24.34	*(0.000)*	10.26	*(0.000)*

Note: The dependent variable is domestic bias as defined in Eq. (1) for investing countries shown in Table 1. The estimation is based on Eq. (5) for annual data over the 2004-2012 period. The constant and dummy variables for individual years are included, but not reported. Robust standard errors are reported in parentheses.
***, **, * denote significance at one, five and ten percent, respectively.

Table 6: Determinants of domestic bond bias (robustness check I)

Domestic bias as dependent variable, financial centers are excluded								
	Hofstede & WVS (1)		**Hofstede & ISSP (2)**		**GLOBE & WVS (3)**		**GLOBE & ISSP (4)**	
Patriotism	**0.104*** **	***(0.09)***	**1.576*** **	***(0.37)***	**-0.014**	***(0.25)***	**0.134**	***(0.28)***
Uncertainty avoidance	**0.007***	***(0.00)***	**0.001**	***(0.00)***	**0.740*** **	***(0.11)***	**-0.231**	***(0.15)***
Individualism/collectivism	**-0.004**	***(0.00)***	**0.012*** **	***(0.00)***	**-1.217*** **	***(0.10)***	**-0.094**	***(0.14)***
Cultural distance	**1.456*** **	***(0.38)***	**-0.458***	***(0.27)***	**0.990*** **	***(0.34)***	**0.030**	***(0.34)***
Bond market development	-31.08***	*(3.68)*	-46.45***	*(4.53)*	-15.65***	*(1.83)*	-22.06***	*(3.83)*
Capital account liberalization	-0.095***	*(0.03)*	0.068***	*(0.03)*	-0.019	*(0.02)*	-0.036	*(0.02)*
Creditor protection	0.053*	*(0.03)*	0.054	*(0.04)*	0.171***	*(0.02)*	0.073***	*(0.03)*
Banking system stability	-0.002	*(0.00)*	-0.004***	*(0.00)*	0.000	*(0.00)*	-0.003**	*(0.00)*
GDP per capita growth	0.031	*(0.67)*	-0.300	*(0.60)*	-0.595	*(0.47)*	0.025	*(0.57)*
Sovereign stability	-0.103***	*(0.02)*	-0.192***	*(0.03)*	-0.216***	*(0.02)*	-0.257***	*(0.04)*
EMU/NAFTA/MERCOSUR/ASEAN membership	0.018	*(0.13)*	0.292*	*(0.17)*	-0.143	*(0.12)*	-0.504***	*(0.11)*
Common border	-0.073**	*(0.03)*	-0.026	*(0.02)*	-0.112***	*(0.02)*	-0.071***	*(0.02)*
Common language	0.006***	*(0.00)*	<0.001	*(0.00)*	<0.001	*(0.00)*	<0.001	*(0.00)*
Geographical distance	1.998***	*(0.36)*	1.338**	*(0.62)*	1.535***	*(0.26)*	1.170**	*(0.49)*
GDP growth correlation with world GDP	-1.204***	*(0.35)*	0.221	*(0.54)*	-1.005***	*(0.23)*	0.881**	*(0.37)*
No. of observations	231		161		207		146	
R-squared adjusted	0.8285		0.9050		0.9188		0.9230	
Wald test for a restricted model (p-value)	4.32	*(0.000)*	8.24	*(0.000)*	54.31	*(0.000)*	1.15	*(0.337)*

Note: The dependent variable is domestic bias as defined in Eq. (1). Financial centers (Hong Kong, Ireland, Japan, Singapore, Switzerland, UK and US) are excluded. The estimation is based on Eq. (5) for annual data over the 2004-2012 period. The constant and dummy variables that account for time effects are included, but not reported. Robust standard errors are reported in parentheses.

***, **, * denote significance at one, five and ten percent, respectively.

Table 7: Determinants of domestic bond bias (robustness check II)

Actual portfolio weight (in %) as dependent variable, total sample								
	Hofstede & WVS (1)		**Hofstede & ISSP (2)**		**GLOBE & WVS (3)**		**GLOBE & ISSP (4)**	
Patriotism	**15.566*** **	***(3.49)***	**13.085*** **	***(4.44)***	**15.305*** **	***(3.48)***	**2.515**	***(3.35)***
Uncertainty avoidance	**0.205*** **	***(0.05)***	**-0.072**	***(0.09)***	**7.378*** **	***(1.85)***	**22.40*** **	***(3.05)***
Individualism/collectivism	**0.133** **	***(0.06)***	**0.173** **	***(0.09)***	**-9.833*** **	***(3.1)***	**-16.00*** **	***(3.42)***
Cultural distance	**10.108**	***(7.20)***	**-4.304**	***(9.14)***	**34.35*** **	***(6.94)***	**46.122*** **	***(4.62)***
Optimal porfolio weight (in %)	1.065***	*(0.17)*	1.324***	*(0.26)*	0.997***	*(0.17)*	0.884***	*(0.23)*
Financial center dummy	-28.31***	*(4.81)*	-36.79***	*(5.48)*	-32.89***	*(2.92)*	-29.68***	*(4.30)*
Bond market development	24.61	*(32.78)*	15.44	*(35.41)*	80.01***	*(21.4)*	45.92**	*(21.61)*
Capital account liberalization	-0.920*	*(0.48)*	-0.331	*(0.55)*	-0.069	*(0.37)*	-0.990**	*(0.42)*
Creditor protection	2.300***	*(0.58)*	4.019***	*(0.86)*	1.731***	*(0.52)*	4.460***	*(0.70)*
Banking system stability	0.085***	*(0.02)*	0.046*	*(0.02)*	0.151***	*(0.02)*	0.088***	*(0.02)*
GDP per capita growth	-4.74	*(10.65)*	12.81	*(14.15)*	2.47	*(11.26)*	-12.48	*(11.57)*
Sovereign stability	-3.943***	*(0.35)*	-4.608***	*(0.44)*	-4.437***	*(0.31)*	-1.142**	*(0.53)*
EMU/NAFTA/MERCOSUR/ASEAN membership	-2.583	*(2.37)*	-6.270	*(4.96)*	-3.726	*(2.79)*	4.199	*(4.73)*
Common border	0.850*	*(0.44)*	0.624	*(0.58)*	0.830*	*(0.44)*	0.684	*(0.44)*
Common language	-0.026	*(0.04)*	-0.082*	*(0.05)*	-0.130***	*(0.03)*	0.131***	*(0.03)*
Geographical distance	25.914***	*(4.85)*	23.532**	*(9.02)*	29.761***	*(5.38)*	21.134**	*(8.11)*
GDP growth correlation with world GDP	4.505	*(6.53)*	-9.094	*(13.71)*	14.941***	*(4.75)*	-50.85***	*(8.96)*
No. of observations	276		201		252		186	
R-squared adjusted	0.7568		0.6960		0.8216		0.8735	
Wald test for a restricted model (p-value)	17.28	*(0.000)*	4.02	*(0.004)*	49.10	*(0.000)*	51.28	*(0.000)*

Note: The dependent variable is the actual portfolio weight assigned to the domestic bonds. The sample encompasses investing countries shown in Table 1. The estimation is based on Eq. (6) for annual data over the 2004-2012 period. The constant and dummy variables that account for time effects are included, but not reported. Robust standard errors are reported in parentheses. ***, **, * denote significance at one, five and ten percent, respectively.

Table 8: Determinants of foreign bias

	WVS patriotism (1)		WVS patriotism & Hofstede's uncertainty avoidance (2)		WVS patriotism & Hofstede's uncertainty avoidance & individualism (3)		Hofstede & WVS (4)		Hofstede & ISSP (5)		GLOBE & WVS (6)		GLOBE & ISSP (7)	
Patriotism	**-0.848*** **	***(0.08)***	**-1.037*** **	***(0.07)***	**-1.016*** **	***(0.08)***	**-1.019*** **	***(0.08)***	**-0.779*** **	***(0.05)***	**-0.495*** **	***(0.08)***	**-0.067**	***(0.07)***
Uncertainty avoidance			**-0.035*** **	***(0.00)***	**-0.035*** **	***(0.00)***	**-0.034*** **	***(0.00)***	**-0.027*** **	***(0.00)***	**-1.000*** **	***(0.06)***	**-1.179*** **	***(0.07)***
Individualism/collectivism					**-0.001**	***(0.001)***	**-0.001**	***(0.001)***	**-0.028*** **	***(0.00)***	**-0.687*** **	***(0.08)***	**0.585*** **	***(0.09)***
Cultural distance							**0.251*** **	***(0.06)***	**0.179*** **	***(0.05)***	**-0.016**	***(0.04)***	**0.126**	***(0.07)***
Domestic bias	-0.181***	*(0.02)*	-0.199***	*(0.02)*	-0.214***	*(0.02)*	-0.208***	*(0.02)*	-0.371***	*(0.02)*	-0.019	*(0.02)*	-0.168***	*(0.02)*
Financial center dummy	1.349***	*(0.07)*	0.902***	*(0.07)*	0.897***	*(0.07)*	0.918***	*(0.07)*	0.507***	*(0.05)*	1.304***	*(0.07)*	0.929***	*(0.06)*
Host country-specific control variables														
Capital account liberalization	-0.063***	*(0.01)*	-0.068***	*(0.01)*	-0.068***	*(0.01)*	-0.072***	*(0.01)*	-0.064***	*(0.01)*	-0.077***	*(0.01)*	-0.082***	*(0.01)*
Creditor protection	0.085***	*(0.01)*	0.097***	*(0.01)*	0.097***	*(0.01)*	0.093***	*(0.01)*	0.061***	*(0.01)*	0.086***	*(0.01)*	0.051***	*(0.01)*
Banking system stability	-0.004***	*(0.00)*	-0.004***	*(0.00)*	-0.004***	*(0.00)*	-0.004***	*(0.00)*	-0.005***	*(0.00)*	-0.005***	*(0.00)*	-0.006***	*(0.00)*
GDP per capita growth	1.766***	*(0.38)*	1.883***	*(0.36)*	1.897***	*(0.36)*	1.878***	*(0.36)*	1.138***	*(0.31)*	1.583***	*(0.40)*	1.052***	*(0.33)*
Sovereign stability	0.006	*(0.01)*	0.005	*(0.01)*	0.004	*(0.01)*	0.004	*(0.01)*	0.010	*(0.01)*	0.024**	*(0.01)*	0.021**	*(0.01)*
Developed dummy	0.276***	*(0.10)*	0.385***	*(0.09)*	0.381***	*(0.10)*	0.375***	*(0.10)*	0.496***	*(0.08)*	0.361***	*(0.11)*	0.483***	*(0.10)*
Bond market development	7.825***	*(0.65)*	8.634***	*(0.61)*	8.615***	*(0.61)*	8.858***	*(0.62)*	9.403***	*(0.51)*	8.763***	*(0.66)*	10.418***	*(0.55)*
Control variables for diversification, familiarity and information asymmetries														
Common legal origin	0.917***	*(0.15)*	0.589***	*(0.14)*	0.614***	*(0.14)*	0.215***	*(0.06)*	0.349***	*(0.05)*	0.370***	*(0.06)*	0.313***	*(0.06)*
Return correlation	-0.087	*(0.06)*	0.177***	*(0.06)*	0.170***	*(0.06)*	0.649***	*(0.14)*	0.756***	*(0.12)*	-0.028	*(0.15)*	0.271**	*(0.13)*
Common border	-0.433***	*(0.11)*	-0.404***	*(0.10)*	-0.413***	*(0.10)*	-0.376***	*(0.10)*	-0.168**	*(0.08)*	-0.401***	*(0.10)*	-0.423***	*(0.08)*
Common language	1.256***	*(0.08)*	0.681***	*(0.08)*	0.689***	*(0.08)*	0.756***	*(0.08)*	0.410***	*(0.07)*	0.876***	*(0.09)*	0.608***	*(0.08)*
Geographical distance	-0.798***	*(0.03)*	-0.865***	*(0.03)*	-0.873***	*(0.03)*	-0.879***	*(0.03)*	-0.570***	*(0.03)*	-0.668***	*(0.04)*	-0.613***	*(0.03)*
Common EMU membership	1.637***	*(0.08)*	1.807***	*(0.07)*	1.791***	*(0.07)*	1.811***	*(0.07)*	1.555***	*(0.06)*	2.433***	*(0.07)*	1.781***	*(0.06)*
Common NAFTA membership	0.023	*(0.32)*	-0.099	*(0.30)*	-0.100	*(0.30)*	-0.132	*(0.29)*	0.185	*(0.15)*	-0.102	*(0.30)*	-0.122	*(0.18)*
Common MERCOSUR membership	-0.680**	*(0.31)*	0.124	*(0.32)*	0.097	*(0.33)*	0.143	*(0.32)*	1.610***	*(0.27)*	-0.115	*(0.38)*		
Common ASEAN membership	1.552***	*(0.17)*	1.000***	*(0.16)*	0.961***	*(0.17)*	1.069***	*(0.17)*	1.523***	*(0.28)*	2.543***	*(0.17)*	3.246***	*(0.28)*
Constant	6.110***	*(0.43)*	9.611***	*(0.42)*	9.759***	*(0.43)*	9.436***	*(0.44)*	9.251***	*(0.48)*	10.439***	*(0.53)*	4.674***	*(0.59)*
No. of observations	7677		7677		7677		7677		6286		6456		5143	
R-squared adjusted	0.3742		0.4464		0.4464		0.4487		0.4819		0.4577		0.5214	
Wald test for a restricted model (p-value)	125.48	*(0.000)*	604.30	*(0.000)*	406.83	*(0.000)*	307.94	*(0.000)*	143.13	*(0.000)*	173.19	*(0.000)*	147.34	*(0.000)*

Note: The analysis is based on Eq. (7) for the annual data over the 2004-2012 period for the countries shown in Table 1. The dependent variable is the foreign bias as defined in Eq. (2). The constant and dummy variables for individual years are included, but not reported. Robust standard errors are reported in parentheses.
***, **, * denote significance at one, five and ten percent, respectively.

Table 9: Determinants of foreign bond bias (robustness check I)

Financial centers are excluded.

	Hofstede & WVS (1)		Hofstede & ISSP (2)		GLOBE & WVS (3)		GLOBE & ISSP (4)	
Patriotism	**-0.082**	***(0.14)***	**0.077**	***(0.09)***	**-1.053*** **	***(0.16)***	**-0.510*** **	***(0.10)***
Uncertainty avoidance	**-0.038*** **	***(0.00)***	**-0.027*** **	***(0.00)***	**-0.790*** **	***(0.09)***	**-1.135*** **	***(0.08)***
Individualism/collectivism	**0.001**	***(0.00)***	**-0.031*** **	***(0.00)***	**-1.048*** **	***(0.10)***	**0.451*** **	***(0.10)***
Cultural distance	**0.246*** **	***(0.07)***	**0.196*** **	***(0.06)***	**-0.059**	***(0.05)***	**0.115**	***(0.08)***
Domestic bias	-0.348***	*(0.03)*	-0.578***	*(0.03)*	-0.412***	*(0.04)*	-0.339***	*(0.04)*
Host country-specific control variables								
Capital account liberalization	-0.072***	*(0.01)*	-0.067***	*(0.01)*	-0.077***	*(0.02)*	-0.090***	*(0.01)*
Creditor protection	0.088***	*(0.02)*	0.057***	*(0.02)*	0.091***	*(0.02)*	0.044***	*(0.02)*
Banking system stability	-0.004***	*(0.00)*	-0.006***	*(0.00)*	-0.005***	*(0.00)*	-0.006***	*(0.00)*
GDP per capita growth	1.860***	*(0.44)*	0.959**	*(0.39)*	1.440***	*(0.49)*	0.958**	*(0.42)*
Sovereign stability	-0.005	*(0.01)*	0.013	*(0.01)*	0.019	*(0.01)*	0.019	*(0.01)*
Developed dummy	0.455***	*(0.12)*	0.586***	*(0.10)*	0.459***	*(0.14)*	0.615***	*(0.12)*
Bond market development	9.352***	*(0.72)*	10.061***	*(0.60)*	9.727***	*(0.78)*	11.893***	*(0.67)*
Control variables for diversification, familiarity and information asymmetries								
Return correlation	0.421**	*(0.18)*	0.418***	*(0.16)*	-0.527***	*(0.20)*	-0.287	*(0.18)*
Common legal origin	0.231***	*(0.07)*	0.408***	*(0.06)*	0.404***	*(0.08)*	0.339***	*(0.07)*
Common border	-0.465***	*(0.11)*	-0.276***	*(0.09)*	-0.301***	*(0.11)*	-0.494***	*(0.10)*
Common language	0.664***	*(0.10)*	0.141*	*(0.09)*	0.612***	*(0.12)*	0.475***	*(0.11)*
Geographical distance	-1.037***	*(0.04)*	-0.688***	*(0.04)*	-0.736***	*(0.05)*	-0.699***	*(0.04)*
Common EMU membership	1.635***	*(0.08)*	1.513***	*(0.07)*	2.300***	*(0.09)*	1.916***	*(0.07)*
Common NAFTA membership	-0.565	*(0.41)*	-0.336	*(0.24)*	-0.928**	*(0.40)*	-0.677**	*(0.33)*
Common MERCOSUR membership	0.311	*(0.33)*	1.858***	*(0.28)*	0.265	*(0.39)*		
Common ASEAN membership	0.909***	*(0.17)*	1.569***	*(0.28)*	2.623***	*(0.18)*	3.414***	*(0.29)*
No. of observations	6065		4845		5002		3849	
R-squared adjusted	0.4305		0.4879		0.4442		0.5284	
Wald test for a restricted model (p-value)	223.03	*(0.000)*	96.14	*(0.000)*	136.12	*(0.000)*	63.09	*(0.000)*

Note: The dependent variable is the foreign bias as defined in Eq. (2). The analysis is based on Eq. (7) for the annual data over the 2004-2012 period. Financial centers (Hong Kong, Ireland, Japan, Singapore, Switzerland, UK and US) are excluded. The constant and dummy variables that are used to account for time fixed effects are included, but not reported. Robust standard errors are reported in parentheses.
The dummy variable that accounts for the common MERCOSUR membership of the host and home countries is omitted in column (4) since there are no common members of the MERCOSUR in the sample that combines the GLOBE cultural variables and the ISSP patriotism.
***, **, * denote significance at one, five and ten percent, respectively.

Table 10: Determinants of foreign bond bias (robustness check II)

Cross-section with averaged data

	Hofstede & WVS (1)		Hofstede & ISSP (2)		GLOBE & WVS (3)		GLOBE & ISSP (4)	
Patriotism	**-0.957*** **	***(0.20)***	**-0.618*** **	***(0.14)***	**-0.349**	***(0.22)***	**0.159**	***(0.17)***
Uncertainty avoidance	**-0.031*** **	***(0.00)***	**-0.024*** **	***(0.00)***	**-1.038*** **	***(0.14)***	**-1.368*** **	***(0.15)***
Individualism/collectivism	**-0.001**	***(0.00)***	**-0.026*** **	***(0.00)***	**-0.721*** **	***(0.18)***	**0.825*** **	***(0.19)***
Cultural distance	**0.341**	***(0.24)***	**0.240**	***(0.14)***	**-0.017**	***(0.08)***	**0.145**	***(0.15)***
Domestic bias	-0.265***	*(0.06)*	-0.488***	*(0.05)*	-0.093*	*(0.05)*	-0.202***	*(0.05)*
Financial center dummy	1.103***	*(0.18)*	0.389***	*(0.14)*	1.379***	*(0.17)*	0.902***	*(0.13)*
Host country-specific control variables								
Capital account liberalization	-0.094***	*(0.03)*	-0.097***	*(0.03)*	-0.113***	*(0.04)*	-0.145***	*(0.03)*
Creditor protection	0.077**	*(0.04)*	0.064*	*(0.03)*	0.062	*(0.04)*	0.057	*(0.04)*
Banking system stability	-0.003**	*(0.00)*	-0.004***	*(0.00)*	-0.004**	*(0.00)*	-0.005***	*(0.00)*
GDP per capita growth	6.043***	*(2.01)*	2.330	*(1.87)*	4.393**	*(2.17)*	2.067	*(1.83)*
Sovereign stability	-0.013	*(0.03)*	0.002	*(0.03)*	0.013	*(0.03)*	0.009	*(0.03)*
Developed dummy	0.747***	*(0.26)*	0.630***	*(0.22)*	0.724**	*(0.33)*	0.785***	*(0.27)*
Bond market development	11.758***	*(1.68)*	11.291***	*(1.34)*	11.634***	*(1.78)*	11.979***	*(1.44)*
Control variables for diversification, familiarity and information asymmetries								
Return correlation	0.705**	*(0.34)*	0.732**	*(0.31)*	-0.232	*(0.37)*	-0.004	*(0.33)*
Common legal origin	0.160	*(0.14)*	0.347***	*(0.13)*	0.311*	*(0.16)*	0.331**	*(0.14)*
Common border	-0.381	*(0.28)*	-0.232	*(0.26)*	-0.454*	*(0.25)*	-0.507**	*(0.23)*
Common language	0.873***	*(0.21)*	0.476***	*(0.17)*	0.946***	*(0.23)*	0.652***	*(0.20)*
Geographical distance	-0.915***	*(0.08)*	-0.661***	*(0.07)*	-0.715***	*(0.10)*	-0.716***	*(0.08)*
Common EMU membership	1.946***	*(0.21)*	1.446***	*(0.17)*	2.641***	*(0.20)*	1.715***	*(0.17)*
Common NAFTA membership	-0.307	*(0.70)*	0.027	*(0.44)*	-0.237	*(0.67)*	-0.263	*(0.56)*
Common MERCOSUR membership	0.403	*(0.79)*	1.982***	*(0.47)*	0.007	*(0.99)*		
Common ASEAN membership	1.513***	*(0.41)*	2.213***	*(0.67)*	2.945***	*(0.38)*	3.655***	*(0.70)*
Constant	9.075***	*(1.13)*	9.306***	*(1.15)*	10.830***	*(1.32)*	4.535***	*(1.42)*
No. of observations	1136		907		911		707	
R-squared adjusted	0.4877		0.5284		0.5058		0.5968	
Wald test for a restricted model (p-value)	44.78	*(0.000)*	19.69	*(0.000)*	27.84	*(0.000)*	30.63	*(0.000)*

Note: The dependent variable is the foreign bias as defined in Eq. (2). The analysis is based on Eq. (7) for the data averaged over the 2004-2012 period. The dummy variable that accounts for the common MERCOSUR membership of the host and home countries is omitted in column (4) since there are no common members of the MERCOSUR in the sample that combines the GLOBE cultural variables and the ISSP patriotism. Robust standard errors are reported in parentheses.

***, **, * denote significance at one, five and ten percent, respectively.

Table 11: Determinants of foreign bond bias (robustness check III)

Actual portfolio weight (in %) as dependent variable, total sample.

	Hofstede & WVS (1)		Hofstede & ISSP (2)		GLOBE & WVS (3)		GLOBE & ISSP (4)	
Patriotism	**-0.542*** **	***(0.05)***	**-0.370*** **	***(0.04)***	**-0.519*** **	***(0.06)***	**-0.164** **	***(0.06)***
Uncertainty avoidance	**-0.010*** **	***(0.00)***	**-0.009*** **	***(0.00)***	**-0.376*** **	***(0.04)***	**-0.455*** **	***(0.05)***
Individualism/collectivism	**-0.003*** **	***(0.00)***	**-0.008*** **	***(0.00)***	**0.024**	***(0.05)***	**0.024**	***(0.08)***
Cultural distance	**-0.009**	***(0.04)***	**-0.052**	***(0.04)***	**0.003**	***(0.02)***	**-0.028**	***(0.02)***
Optimal portfolio weight (in %)	0.106***	*(0.01)*	0.099***	*(0.01)*	0.098***	*(0.01)*	0.092***	*(0.01)*
Domestic bias	-0.009	*(0.01)*	-0.040***	*(0.01)*	-0.112***	*(0.01)*	0.043***	*(0.01)*
Financial center dummy	0.482***	*(0.06)*	0.441***	*(0.05)*	0.745***	*(0.07)*	0.630***	*(0.06)*
Host country-specific control variables								
Capital account liberalization	-0.019***	*(0.00)*	-0.029***	*(0.01)*	-0.020***	*(0.01)*	-0.034***	*(0.01)*
Creditor protection	-0.007	*(0.01)*	-0.032***	*(0.01)*	-0.016**	*(0.01)*	-0.042***	*(0.01)*
Banking system stability	-0.002***	*(0.00)*	-0.002***	*(0.00)*	-0.002***	*(0.00)*	-0.002***	*(0.00)*
GDP per capita growth	0.460***	*(0.18)*	0.523***	*(0.20)*	0.342*	*(0.19)*	0.492**	*(0.21)*
Sovereign stability	-0.004	*(0.00)*	0.004	*(0.00)*	0.007	*(0.00)*	0.015***	*(0.00)*
Developed dummy	0.129***	*(0.03)*	0.191***	*(0.03)*	0.084**	*(0.04)*	0.127***	*(0.04)*
Bond market development	11.385***	*(0.66)*	15.953***	*(0.79)*	11.211***	*(0.70)*	15.896***	*(0.78)*
Control variables for diversification, familiarity and information asymmetries								
Return correlation	1.3351***	*(0.12)*	0.812***	*(0.10)*	1.211***	*(0.13)*	0.707***	*(0.10)*
Common legal origin	0.068**	*(0.03)*	0.137***	*(0.04)*	0.125***	*(0.03)*	0.235***	*(0.04)*
Common border	0.282***	*(0.09)*	0.639***	*(0.11)*	0.526***	*(0.11)*	0.935***	*(0.13)*
Common language	0.317***	*(0.06)*	0.099	*(0.06)*	0.460***	*(0.06)*	0.189***	*(0.07)*
Geographical distance	-0.075***	*(0.02)*	-0.055***	*(0.02)*	0.000	*(0.02)*	-0.067***	*(0.02)*
Common EMU membership	0.724***	*(0.07)*	0.879***	*(0.06)*	0.973***	*(0.08)*	1.073***	*(0.08)*
Common NAFTA membership	0.286	*(0.30)*	0.123	*(0.22)*	0.355	*(0.30)*	-0.184	*(0.23)*
Common MERCOSUR membership	-0.167***	*(0.06)*	-0.377***	*(0.13)*	-0.386***	*(0.08)*		
Common ASEAN membership	-0.008	*(0.06)*	0.168**	*(0.08)*	0.406***	*(0.06)*	0.880***	*(0.07)*
No. of observations	7677		6286		6456		5143	
R-squared adjusted	0.4922		0.5278		0.5015		0.5543	
Wald test for a restricted model (p-value)	64.45	*(0.000)*	59.01	*(0.000)*	73.75	*(0.000)*	50.24	*(0.000)*

Note: The dependent variable is the actual portfolio weight assigned to foreign debt securities. The analysis is based on Eq. (8) for the annual data over the 2004-2012 period. The constant and dummy variables for individual years are included, but not reported. The dummy variable that accounts for the common MERCOSUR membership of the host and home countries is omitted in column (4) since there are no common members of the MERCOSUR in the sample that combines the GLOBE cultural variables and the ISSP patriotism. Robust standard errors are reported in parentheses.

***, **, * denote significance at one, five and ten percent, respectively.

Financialization of Agricultural Futures Markets: Evidence from Quantile Regressions

Elina Pradkhan

Humboldt University of Berlin
Institute of Finance
elina.pradkhan@hu-berlin.de

Abstract

This study analyzes the relationship between financial activity and price returns in twelve agricultural futures markets. Contrary to the existing research that relies on the Granger causality in mean, it explores causal effects from the perspective of conditional quantiles. The comparison of Granger causality in mean and Granger causality at individual quantiles shows that the absence of Granger causality in mean does not necessarily rule out the existence of Granger-causal effects from positions of speculators and index traders to price returns in a wide range of commodity markets such as cocoa, coffee, corn, sugar and SRW wheat.

JEL classifications: C22, D84, G13, Q02

Keywords: futures markets, Granger causality, quantile regressions, commodity index traders, speculation.

1 Introduction

The 2005-2008 and 2010-2011 commodity price booms have raised concerns about the role of speculators and index traders in the observed price bubbles and calls for tighter regulation and closer supervision of speculative activity in futures markets have become more urgent (Masters, 2008). The US Commodity Futures Trading Commission (CFTC) proposed to re-consider and establish limits on speculative positions in 28 physical commodity futures and option contracts in November 2013. The initiated public roundtable for the Aggregation and Position Limits Proposals ended in July 2014, and the discussion on the scope of and the exemption from the position limits still goes on. The aim is to contain excessive speculation in the agricultural, energy and metals futures markets.

There are several ways through which speculators may affect the price mechanism. A price impact may manifest itself if traders possess private information about commodity fundamentals and/or in case of market illiquidity (Gilbert and Pfuderer, 2014). Singleton (2014) argues that, in the "differences of opinion" equilibrium, heterogeneous beliefs about the publicly available information may induce a price impact even in the absence of private information. Based on the "differences of opinion" equilibrium, Fische et al. (2014) show that money managers benefit from strong price signals such that their trading decisions have the potential to affect prices.

Granger causality tests play an important role in the empirical research on the role of speculators and index traders in the price mechanism of agricultural spot and futures markets. Many empirical studies do not find any evidence of a significant Granger-causal relationship between financial activity and futures returns (e.g. Irwin et al., 2009; Brunetti et al., 2011a). In this respect, Gilbert and Pfuderer (2014) argue that trading activity should be impounded in prices instantaneously such that causation from past variables that are lagged by one week is unlikely to be detected in liquid markets. Another possible explanation for the failure to detect any Granger causality from trader positions to returns may be the non-linearity of the causal relationship in different parts of the distribution of the dependent variable (Chuang et al., 2009). For instance, in the context of stock markets, several studies have demonstrated that, in spite of the rejection of the Granger causality in mean, a significant Granger-causal relationship between trading volume and returns exists at individual quantiles (Chuang et al., 2009; Gebka and Wohar, 2013).

An analysis of Granger-causal effects at individual quantiles may be a valuable complement to the Granger causality in mean. First, the price impact of a single trader category may manifest itself particularly strongly only in periods of rising or falling prices (i.e. at high or low quantiles of the return distribution). Second, if the impact of positions on subsequent returns is positive at

some quantiles and negative at other quantiles, the positive and negative causal effects may cancel each other out in the least squares estimations such that no Granger causality in mean is detected (Chuang et al., 2009). Non-linearity of the causal relationship between trader positions and returns is not an implausible assumption. For instance, non-informational trades that are recognized and corrected by market participants should be associated with negative Granger causality from past growth in net long positions to returns. Positive Granger causality may arise in case of trades that trigger positive feedback trading of other market participants and, thus, result in price effects that persist for a week or longer.

This study focuses on three major trader categories that are associated with the financialization of commodity futures markets: commodity index investors, money managers and other reportables. Commodity index investors are institutional investors who gain a long-side exposure to commodity futures contracts in order to replicate returns on tradable commodity futures indices. The impact of index traders on the price mechanism in agricultural futures markets has been extensively examined. This paper complements the existing research on this trader category by exploring the Granger-causal relationships at individual quantiles of the return distribution. Moreover, this study splits the extensively examined category of non-commercial traders into money managers and other reportables and separately analyzes the potential price impact of these two trader categories that are commonly associated with speculation. Money managers are e.g. hedge funds that trade in commodity derivatives and are regarded as professional speculators. Other reportables are traders that are large enough to report, but cannot be classified as money managers.

My results suggest that there is evidence of Granger causality in mean from positions to returns for money managers in coffee and live cattle markets, for other reportables in the lean hogs market and for index traders in the cocoa market. Furthermore, quantile regressions indicate that significant Granger-causal relationships from trader positions to returns exist at individual quantiles for money managers in cocoa, feeder cattle, sugar and SRW wheat markets, for other reportables in cocoa, coffee, soybeans and SRW wheat markets and for index traders in the corn market. Positions of money managers seem to lead prices in sugar and SRW wheat markets in the upper part of the return distribution, whereas the forecasting power in the cocoa market manifests itself only in periods associated with negative returns. Granger causality from positions of other reportables to returns can be observed at low quantiles of the return distribution (i.e. in periods of falling prices) in the cocoa market and at high quantiles (i.e. in periods of rising prices) in coffee, soybeans and SRW wheat markets. The negative Granger-causal effects of index traders' positions on corn returns manifest themselves predominantly at low quantiles of the return distribution.

This paper is structured as follows. Section 2 summarizes the existing literature. In Section 3, different trader categories are presented. Section 4 outlines the data and the empirical model. The results are presented in Section 5. Section 6 concludes.

2 Literature Review

The financialization of agricultural futures markets and especially the increasing participation of index traders have attracted considerable attention of researchers. One strand of literature primarily focuses on speculative bubbles (e.g. Gilbert, 2010b; Guttierrez, 2013; Etienne et al., 2014; Adämmer and Bohl, 2015). For instance, Guttierez (2013) detects explosive price behavior for CBOT wheat, corn, rice and, to a lesser extent, soybeans futures prices in the 2007-2008 period. Etienne et al. (2014) show that, albeit subject to multiple periods of price explosiveness, the life time of most bubbles does not typically exceed ten days and that the sensitivity of agricultural futures markets to bubbles was lower during the 2006-2011 compared to the 1971-1976 period. Adämmer and Bohl (2015) detect speculative bubbles in the wheat market over the 2003-2013 period. Several studies examine the linkages and spillovers between agricultural and financial markets, inter alia during the recent financial crisis (e.g. Silvennoinen and Thorp, 2013; Mensi et al., 2013; Gao and Liu, 2014). Another strand of literature explores the impact of speculators and index traders on the price mechanism: spot and/or futures returns (e.g. Stoll and Whaley, 2011; Hamilton and Wu, 2014; Sanders and Irwin, 2011), realized and conditional volatilities (e.g. Brunetti et al., 2011a; Bohl and Stephan, 2013; Manera et al., 2012) as well as spreads between nearby and first deferred contracts (e.g. Stoll and Whaley, 2011; Aulerich et al., 2013; Mou, 2011; Brunetti and Reiffen, 2014).

Granger causality tests play a very important role in the empirical research on the price impact of financialization in agricultural markets.[1] Compared to the traditional time-series Granger causality, cross-sectional and panel Granger causality tests have gained increasing importance. In this respect, Sanders and Irwin (2010) and Irwin and Sanders (2012a) argue that traditional time-series Granger causality tests fail to reject the null hypothesis of non-causality due to a high volatility of price returns. Thus, they analyze the relationship between futures returns and lagged (and contemporaneous) growth in positions of index traders by means of cross-sectional tests using Fama-MacBeth regressions. Both studies find no evidence that index investment is linked to high commodity futures prices. Sanders and Irwin (2011), Capelle-Blancard and Coulibaly (2011) and Aulerich et al. (2013) also question the statistical power of the time-series Granger causality for individual commodity markets and use the SUR (seemingly unrelated

[1] See the reviews of literature by Irwin and Sanders (2011), Irwin and Sanders (2012b), Irwin (2013) and Grosche (2014).

regression) framework. Sanders and Irwin (2011) find no evidence of any significant Granger-causal effects of index traders' positions on futures returns. Capelle-Blancard and Coulibaly (2011) confirm a marginally significant, positive effect of net long positions of index traders on futures returns only for live cattle. Aulerich et al. (2013) find a significant, but negative Granger causality from positions of index traders to returns only in markets for lean hogs, feeder cattle and KCBOT wheat.

While the Granger causality framework relates past trader positions to subsequent returns or volatilities, a comparatively small number of studies explore the contemporaneous relationship between speculative activity and returns and/or volatilities (e.g. Manera et al., 2013). However, a significant contemporaneous relation cannot be interpreted as a causal effect of positions on prices due to the endogeneity bias. Gilbert and Pfuderer (2014) avoid the endogeneity bias by using the instrumental variables approach. They focus on major grains and oilseed markets and find evidence of a significant and positive contemporaneous impact of index traders in the soybeans, soybean oil and KCBOT wheat markets. Tang and Xiong (2012) also move away from the traditional Granger causality approach. They compare return correlations between indexed (i.e. included in most important commodity indices S&P GSCI and DJ-UBSCI) and off-index non-energy commodities with oil that has a dominant weight in both S&P GSCI and DJ-UBSCI and surmise that any significant increase of return correlations with oil of indexed vis-à-vis non-indexed commodities may be interpreted as an influence of index investors on the price mechanism (Tang and Xiong, 2012).

There exist several extensive reviews of literature on the impact of commodity index traders on the price mechanism in agricultural futures markets (e.g. Irwin and Sanders, 2011; Irwin and Sanders, 2012b; Irwin, 2013; Grosche, 2014). These studies conclude that most empirical evidence is inconsistent with the allegations that passive index investment may have affected the price mechanism in agricultural spot and futures markets (e.g. Irwin and Sanders, 2012b; Irwin, 2013). If there is any significant evidence of Granger causality, it is predominantly outside the grains markets (Grosche, 2014). However, the recent evidence of Gilbert and Pfuderer (2014) suggests that reliance on the Granger causality approach may underestimate the causal relationship between the trading activity of index traders and commodity returns.

Compared to index traders, speculators have received less attention in the empirical research on agricultural futures markets. Irwin et al. (2009) review several studies on the impact of non-commercial traders on prices and conclude that there is little evidence that non-commercial traders' positions forecast subsequent futures returns in agricultural markets. By contrast, based on rolling Granger causality tests, Cooke and Robles (2009) show that past positions of non-

commercial traders have influenced spot prices in corn, rice, soybeans and wheat markets during the 2006-2008 period. For corn, Brunetti et al. (2011a) use daily data on individual trader positions from the Large Trader Reporting System (LTRS) of the CFTC: merchants, manufacturers, floor brokers, swap dealers and hedge funds. Granger causality from positions to corn returns can be confirmed only for merchants, but not for hedge funds (Brunetti et al, 2011a). Borin and Di Nino (2012) explore the impact of money managers' long and short positions on futures returns and volatilities in eleven agricultural futures markets. They find a significant impact of past returns on positions of money managers, but evidence of Granger causality from positions to returns is detected only in feeder and live cattle markets (Borin and Di Nino, 2012). Mayer (2012) incorporates the positions of both index traders and money managers in the analysis of Granger causality in wheat, maize, soybeans and soybean oil markets and detects Granger causality from positions to returns only in the maize market for money managers and in the soybeans and soybean oil markets for index traders. Brunetti et al. (2011b) explore the potential asymmetries in bull and bear market regimes and argue that hedge funds have the potential to predict price reversals in the corn futures market.

Although Granger causality was initially developed for conditional distributions, the existing studies on speculation test only Granger causality in mean. However, the absence of Granger causality in mean does not rule out Granger causality in other parts of the distribution. Quantile regression methodology has gained increasing recognition in empirical economics. This approach offers a valuable alternative to the traditional estimation of the conditional mean and has been rapidly expanding in various areas such as labor economics (e.g. Buchinsky, 1998a; Garcia et al., 2001), microeconomics (e.g. Goel and Ram, 2004), macroeconomics and monetary policy (e.g. Lee and Yang, 2012) as well as corporate finance (Fattouh et al., 2005). Kuralbayeva and Malone (2012) use quantile regressions in the context of commodity markets in order to explore the impact of global financial and commodity-specific factors on extreme commodity spot price movements.

Quantile regressions are typically applied in the context of cross-sections (e.g. in order to account for the different size of households and firms). However, Chuang et al. (2009) and Gebka and Wohar (2013) extend the quantile regression approach to the time-series dimension. Both studies focus on Granger-causal relationships from trading volume to stock returns and show that, despite the rejection of Granger causality in mean, significant Granger-causal effects exist at individual quantiles. The failure to confirm the Granger causality in mean is assumed to be due to the non-linearity in the causal relationship between trading volume and returns (Chuang et al., 2009). Gebka and Wohar (2013) predict a negative impact of trading volume on subsequent returns at low quantiles of the return distribution and a positive impact at high

quantiles. Tests of Granger causality in mean may fail to unveil significant Granger-causal effects if positive and negative causal effects cancel each other out in the least-squares estimations (Chuang et al., 2009).

This study complements the growing literature on speculation in agricultural futures markets in two ways. First, this paper uses quantile regressions that address asymmetries and allow the identification of non-linear relationships between speculative activity and commodity futures returns. Second, in addition to commodity index traders, it explores the potential price impact of the two trader categories that are commonly associated with speculation: money managers and other reportables. Whereas there is comparatively little coverage of the trading activity of money managers and their potential price impact, other reportables have received even less attention in the empirical literature on speculation in agricultural futures markets.

3 Index Traders, Money Managers and Other Reportables

Traditionally, the US Commodity Futures Trading Commission had distinguished two general motivations for trading in futures markets: hedging price risks in the underlying cash markets and speculation on future price movements (CFTC, 2006). According to these two general purposes of trading, the Commitments of Traders (COT) report identifies two categories of reportable traders: commercial and non-commercial traders (CFTC, 2006). Commercial traders are engaged in a commercial activity with commodities, bear the price risk in the spot market and enter futures markets in order to hedge the originating price risk in the underlying cash market (CFTC, 2008). Non-commercial traders take a view on future price movements, do not have any exposure to a physical commodity, offset their positions in futures contracts at expiration and do not make or accept a physical delivery of a commodity (CFTC, 2008).

The Disaggregated Commitments of Traders (DCOT) report enhances the disclosure on commercial and non-commercial traders. It disaggregates the commercial traders into producers /merchants/processors/users and swap dealers, whereas the non-commercial trader category is broken up into managed money and other reportables (CFTC, 2009). Managed money (or money managers) are registered commodity trading advisors, registered commodity pool operators and unregistered funds that are supposed to be engaged in organized futures trading on clients' behalf (CFTC, 2009). Commodity pool operators are e.g. hedge funds that trade in commodity derivatives, whereas hedge funds that provide advice to their clients register with the CFTC as commodity trading advisors (CFTC, 2009). Mayer (2009) argues that returns and not diversification considerations are the major drivers of the activity of money managers in futures markets.

Contrary to money managers, other reportables are not professional speculators. Currently, the CFTC disclosure provides little insight into this trader category. Other reportables are defined as "a wide array of other non-commercial (speculative) traders" (CFTC, 2009). They are large enough to report, but cannot be classified as money managers (CFTC, 2009). According to Irwin and Sanders (2012a), the "other reportables" category includes individual speculative traders, market makers and firms managing their own assets. In case of crude oil, Tokic (2012) assumes that other reportables are large proprietary funds and hypothesizes that these traders are fundamentally oriented investors who act as arbitrageurs.

With the rising participation of commodity index investors whose intentions cannot be classified as either hedging or speculation, the CFTC has started to publish data on positions of commodity index investors within the CIT supplement to the COT report (CFTC, 2006). Whereas money managers "represent the more traditional class of speculative traders" (Irwin and Sanders, 2012a) and other reportables are defined as "a wide array of other non-commercial (speculative) traders" (CFTC, 2009), index traders cannot be classified as speculators in the sense of the CFTC definition of non-commercials as "traders who use futures markets to speculate on the future direction of price movements and are generally sensitive to fundamental and/or technical factors that might influence prices" (CFTC, 2006). For commodity index investors, the general purpose of entering futures markets is to gain a long-side exposure to a broad index of commodities as an asset class (CFTC, 2006). Commodity index investors are e.g. managed funds, pension funds and other institutional investors who invest in commodities as an asset class in a passively managed way (CFTC, 2006). They do not seek to profit from price movements, but obtain a long-side exposure to a wide range of commodities for diversification purposes (CFTC, 2006). Typically, index investors track a broad index of commodities such as S&P GSCI and DJ-UBSCI (CFTC, 2008).

Table 1 shows the average net long positions (i.e. the differences between long and short positions scaled by open interest) of index traders, money managers and other reportables over the 2006-2013 period. Compared to index traders and money managers, net long positions of other reportables account for a lower fraction of open interest. However, low net long positions should not be equated with economic insignificance. The other reportables' average long (short) positions scaled by open interest range from 0.04 (0.03) in cocoa (cocoa and sugar) markets to 0.10 (0.11) in corn (feeder cattle) markets.

There are considerable differences between index traders and traditional speculators (money managers and other reportables). First, whereas money managers and other reportables typically enter both short and long positions, commodity index investment implies long positions in

commodity futures contracts.[2] Second, diversification as well as hedging inflation and the USD depreciation risks are recognized as major drivers of commodity index investors who track a broad index of commodities and, thus, gain a long-side exposure to several commodity futures simultaneously (Irwin and Sanders, 2011; Tokic, 2011; Brunetti and Reiffen, 2014). By contrast, money managers typically attach less importance to diversification motives and trade based on their expectations about individual commodity price movements in order to earn profits (Mayer, 2009). Third, investment horizons differ. Index investors gain a long-side commodity exposure over a longer period of time by rolling their futures positions from the expiring to the next deferred contract (Gilbert, 2010a). Money managers typically have short-term investment horizons (Mayer, 2009). Finally, whereas money managers and other reportables pursue active investment strategies by trading based on their expectations about future price movements, the CFTC designates the investment strategy of index traders as "passive" in the sense that it implies only a limited discretion with regard to trading decisions: Index traders track a broad index of commodities which is calculated and adjusted based on transparent mathematical rules (CFTC, 2006). However, Gilbert and Pfuderer (2014) argue that index investors may equally pursue an active investment strategy if they trade based on their expectations about returns on commodities as an asset class relative to returns on other assets such as bonds or equities.

In order to gain some insight in the investment strategies of the three trader categories, I investigate the role of individual commodity returns for investment decisions of index traders, money managers and other reportables. Changes in net long positions are regressed on changes in net long positions lagged by one week, last week's returns and last week's changes in control variables (spot oil price, MSCI emerging markets index, USD index spot rate and the S&P 500 index). Table 2 summarizes the estimation results.

In general, returns do not forecast changes in net long positions of index traders (Table 2). This evidence confirms the notion that index traders do not take a view on individual commodities and that return considerations may be of minor importance. The slope coefficient on the lagged return variable is significant only in markets for cotton, lean hogs and sugar. In these markets, it takes a negative sign that is consistent with the idea that index traders strive to maintain fixed shares of commodities in their portfolios. For other reportables, negative feedback trading is

[2] However, only a comparatively small number of investors replicate a commodity index by establishing long positions in the respective commodities, whereas entering into OTC swap contracts or purchasing exchange-traded funds or exchange-traded notes is more common (Irwin and Sanders, 2011). Larger index traders obtain commodity exposure through swap dealers (CFTC, 2008). Independently of the investment vehicle chosen, the consequence is an increase in long futures positions in the commodities that make up the index (CFTC, 2008).

more pronounced: The coefficient estimate on lagged returns is negative and significant in half of the examined markets: cocoa, coffee, live cattle, soybean oil, SRW wheat and sugar. Negative feedback trading is consistent with "buy low, sell high" strategies.

By contrast, the growth in net long positions of money managers is positively and significantly related to past returns in all twelve commodity futures markets. Tokic (2012) argues that money managers may act as rational speculators who purposely enter long futures positions in order to artificially create a trend of rising prices that triggers positive feedback trading of other less informed investors. Then, a rational speculator sells his initial position at profit (Tokic, 2012). However, an artificial trend creation is arguable given a highly significant and positive Granger causality from past returns to changes in money managers' positions in all examined agricultural futures markets. The significant coefficient estimate on the lagged return variable may be an indication that return considerations are an important determinant of the investment strategy of money managers.

4 Data and Methodology

4.1 Data

Prices

The relationship between speculative activity and subsequent futures returns is examined for twelve agricultural markets: CBOT Corn, CBOT Soybeans, CBOT Soybean Oil, CBOT SRW Wheat (formerly listed as CBOT Wheat), ICE Futures U.S. Cotton No. 2, CBOT HRW Wheat (formerly listed as KCBT Hard Winter Wheat), CME Feeder Cattle, CME Lean Hogs, CME Live Cattle, ICE Futures U.S. Cocoa, ICE Futures U.S. Coffee C and ICE Futures U.S. Sugar No. 11. Data on futures prices are collected from Datastream. A continuous series of futures prices is created by adopting the rolling procedure of Brunetti and Buyuksahin (2009). The switch to the second-nearby contract occurs when the open interest of the second-nearby contract is higher than the open interest of the first-nearby contract. Carchano and Pardo (2009) argue that this rolling strategy reflects the assumption that traders prefer liquidity peaks to switch between contracts. This rolling procedure allows the calculation of weekly returns R_t that are computed as $R_t = \ln(\frac{P_t}{P_{t-1}})$. If switching between contracts takes place at time $\tilde{t}$, the return $R_{\tilde{t}}$ is calculated based on the prices of the second-nearby contract $P_{\tilde{t}}$ and $P_{\tilde{t}-1}$. Table 1 summarizes the descriptive statistics for returns in each of the twelve futures markets over the period from January 10, 2006 to December 31, 2013.

Positions

As a proxy for the activity of different trader categories, net long positions (difference between long and short Tuesday's closing positions) that are scaled by open interest are used. Scaling by open interest reflects the idea that it is the relative, not the absolute magnitude of position holdings that impacts prices. The weekly positions are drawn from the DCOT report for money managers and other reportables, whereas the data on positions of index traders are taken from the CIT supplement to the COT report. The reports that are published each Friday disclose the Tuesday's closing positions of traders. For money managers and other reportables, the position data is available from June 13, 2006 onwards. For index traders, the disclosure goes back to January 3, 2006.

Whereas Borin and Di Nino (2012) differentiate between long and short positions, this study focuses on net long positions that are computed as the difference between long and short positions scaled by open interest. Although both long and short positions may induce a price impact, these effects may cancel each other out once net long positions are considered. After all, the speculative position limits of the CFTC are determined by net long (or net short) positions.

To ensure stationarity, weekly changes in net long positions scaled by open interest are used. Table 1 summarizes the descriptive statistics for net long positions of each trader category and the unit root tests for the corresponding weekly changes. The null hypothesis of a unit root cannot be rejected for net long positions of money managers in the live cattle market, other reportables in the corn market and index traders in the live cattle, lean hogs and soybeans markets (Table 1). In these cases, I test for cointegration between net long positions and price levels.[3] The Johansen test does not support the hypothesis that prices and positions are cointegrated.

As far as positions of index traders are concerned, one important limitation of relying on the CIT supplement to the COT report is that it includes all positions of a trader who is classified as an index trader, not just those that reflect the exposure to a broad commodity index (CFTC, 2006). Thus, our data potentially overestimate the net long positions that are related to commodity index investment.

Another important limitation is that the data availability does not allow a clear-cut distinction of index traders from money managers and other reportables. Although the swap dealers are typically used as a proxy for index investors (Brunetti and Buyuksahin, 2009; Buyuksahin and

[3] The price index is constructed based on weekly returns R_t obtained from the rollover as $P_t = P_{t-1} * e^{R_t}$ with $P_0 = 100$ on January 3, 2006.

Harris, 2011; Sanders and Irwin, 2011), the data on positions of index traders in the supplemental report are drawn both from both the commercial and non-commercial categories of the COT report. Commercial traders (e.g. some swap dealers) who enter futures markets to hedge OTC transactions related to commodity indices are classified as index traders (CFTC, 2006). Non-commercial traders such as managed and pension funds that gain exposure to commodities as an asset class in an unleveraged and passively-managed way are also considered as index traders (CFTC, 2006, 2009). Thus, it cannot be excluded that some money managers and other reportables, which constitute the two subgroups of the non-commercial trader category, are classified as index traders. In this case, their positions are reflected in net long positions of index traders, while positions of some index traders are also included in the DCOT disclosure on money managers and other reportables.

However, the predominantly negative correlations of changes in money managers' and other reportables' net long positions with changes in net long positions of index traders indicate little relationship between these trader categories (Table 3). Positive correlations are observed in markets for feeder cattle and HRW wheat (for money managers) as well as for cotton and live cattle (for other reportables). These correlations are relatively moderate: The highest positive correlation is observed in the HRW wheat market (0.17). In general, Table 3 shows that changes in net long positions of the three trader types (money managers, other reportables and index traders) are predominantly negatively correlated with each other. Hence, it may not be very inaccurate to treat index traders, money managers and other reportables as completely separate trader groups. Neverheless, it should be borne in mind that there is a potential overlapping between index traders and money managers as well as index traders and other reportables.

4.2 Methodology

Granger Causality

According to Granger (1980), the speculative activity S_{t-1} Granger-causes the subsequent return R_t if:

$$F_{R_t}(\eta|(\mathcal{R},\mathcal{S})_{t-1}) \neq F_{R_t}(\eta|\mathcal{R}_{t-1}) \text{ for any } \eta \in \mathbb{R} \quad (1).$$

F_{R_t} is the conditional distribution of the random variable R_t. $(\mathcal{R},\mathcal{S})_{t-1}$ encompasses all information generated by random variables R and S up to time $t-1$, whereas $\mathcal{R}_{t-1}$ denotes the information set that is associated with the random variable R and excludes information associated with the speculative activity S. Granger causality implies that information related to the trading activity S_{t-1} is crucial to the conditional distribution of the random return variable

R_t (Granger, 1980). In other words, the trading activity S_{t-1} is useful in forecasting the future return R_t (Hamilton, 1994). Eq. (1) describes the initial concept of Granger causality, namely the Granger causality in distribution (Chuang et al., 2009).

Given the computational difficulties related to estimating and testing conditional distributions, the corresponding necessary condition for Granger causality, the so called Granger causality in mean, is preferred by the existing studies (Chuang et al., 2009):

$$\mathrm{E}[(R_t|(\mathcal{R},\mathcal{S})_{t-1})] \neq \mathrm{E}(R_t|\mathcal{R}_{t-1}) \quad (2).$$

$\mathrm{E}(R_t|\mathcal{F})$ denotes the mean of the conditional distribution $F_{R_t}(.|\mathcal{F})$. Granger causality in mean (as specified by Eq. (2)) is tested based on the following ADL model:

$$R_t = \alpha + \sum_{i=1}^{n} \gamma_i * R_{t-i} + \sum_{j=1}^{m} \beta_j * S_{t-j} + \varepsilon_t \quad (3).$$

Eq. (3) relates the return R_t to its own lagged values $R_{t-1}, \dots, R_{t-n}$ and past realizations of the speculative activity $S_{t-1}, \dots, S_{t-m}$. If the null hypothesis of no Granger causality, $\beta_j = 0 \; \forall j = 1, \dots, m$, cannot be rejected, it can be concluded that speculative activity does not Granger-cause commodity returns in mean. In this case, adding past values of speculative activity $S_{t-1}, \dots, S_{t-m}$ to the information set does not improve the forecast of the return variable R_t (Hamilton, 1994). Importantly, the rejection of Granger causality may be the consequence of semi-strong information efficiency and, thus, does not allow any inferences regarding the absence of any impact of traders on the price mechanism (Grosche, 2014). Moreover, the rejection of Granger causality in mean does not necessarily imply that there is no Granger causality in other parts of the distribution or in other moments (Chuang et al., 2009; Gebka and Wohar, 2013).

If $Q_{R_t}(\theta|\mathcal{F})$ denotes the θth quantile of $F_{R_t}(.|\mathcal{F})$, Granger non-causality in distribution is equivalent to Granger non-causality at all quantiles $\theta \in (0,1)$ and can be summarized as (Chuang et al., 2009):

$$Q_{R_t}(\theta|(\mathcal{R},\mathcal{S})_{t-1}) = Q_{R_t}(\theta|\mathcal{R}_{t-1}) \;\; \forall\, \theta \in (0,1) \quad (4).$$

Chuang et al. (2009) test Granger non-causality in the entire distribution as specified by Eq. (4). However, the concept of Granger causality can be extended to either a particular quantile (Lee and Yang, 2012) or a quantile range (Gebka and Wohar, 2013). This study focuses on Granger-causal effects at individual quantiles.

Quantile Regressions

Quantile regressions estimate a linear relationship between a specified quantile of the dependent variable and a set of regressors. The quantile function $Q_{R_t}(\theta|\mathcal{F})$ denotes the distribution of the response variable R_t conditional on the covariates Z_{t-1} at the θth quantile:

$$Q_{R_t}(\theta|\mathcal{F}) = Z_{t-1}^{'}\xi(\theta) \quad (5).$$

$Z_{t-1} = (1, R_{t-1}, \dots, R_{t-n}, S_{t-1}, \dots, S_{t-m})$ is the vector of explanatory variables. ξ is the parameter vector with $\xi^{'} = (\alpha, \gamma_1, \dots, \gamma_n, \beta_1, \dots, \beta_m)$. Contrary to traditional mean models that assume that the mean equation accurately describes all parts of distribution, the quantile approach allows the conditional quantile function $Q_{R_t}(\theta|\mathcal{F})$ to vary across quantiles. Whereas the traditional ordinary least squares estimator minimizes the sum of squared residuals, the least absolute deviations (LAD) estimator minimizes the sum of asymmetrically weighted absolute residuals (Koenker and Hallock, 2001). For a given quantile θ, the LAD estimator determines the parameter vector $\hat{\xi}(\theta)$ as the solution to the following minimization problem (Koenker and Hallock, 2001; Gebka and Wohar, 2013):

$$min_{\xi}\left\{\sum_{t:R_t \geq Z_{t-1}^{'}\xi} \theta * \left|R_t - Z_{t-1}^{'}\xi\right| + \sum_{t:R_t < Z_{t-1}^{'}\xi}(1-\theta) * \left|R_t - Z_{t-1}^{'}\xi\right|\right\} \quad (6).$$

It is worth clarifying that the LAD estimator uses all available observations in estimating any quantile.

The major advantage of the quantile estimation as compared to the ordinary least squares estimator is a more profound characterization of the data. Coefficient estimates obtained for individual quantiles allow for the possibility that the dependent variable reacts differently to the same set of explanatory variables at various points of its conditional distribution (e.g. Buchinsky, 1998b). For instance, positive Granger-causal effects at high quantiles may efface negative Granger-causal effects at lower quantiles in a least squares estimation such that no Granger causality in mean is detected although significant Granger-causal effects exist at individual qunatiles. Moreover, quantile regressions account for the possibility that the potential price impact or significant Granger causality from positions to returns may manifest itself particularly strongly only in periods of rising or falling prices, i.e. at high or low quantiles of the return distribution.

Granger Causality in Mean and at Individual Quantiles

For each of the twelve commodity markets and each trader category, Granger causality in mean is tested based on the following ADL model that relates weekly futures returns R_t to lagged

weekly changes in net long positions of traders (either money managers or other reportables or index traders) S_{t-1}:

$$R_t = \alpha + \sum_{i=1}^{n} \gamma_i * R_{t-i} + \sum_{j=1}^{m} \beta_j * S_{t-j} + \sum_{q=1}^{p} \delta_q^{CV} * CV_{t-q} + \varepsilon_t \quad (7).$$

CV_t is the vector of control variables: weekly changes in the USD index spot rate, the S&P 500 index, the MSCI emerging markets index and the spot oil price.[4] Rising demand from emerging markets, production costs (inter alia determined by the oil price) and the USD value are cited as important determinants of food prices (Mitchell, 2008; Cooke and Robles, 2009; Abbott et al., 2011; Tang and Xiong, 2012). Moreover, several studies document a link between commodity and stock markets (Silvennoinen and Thorp, 2013; Mensi et al., 2013). In addition, the incorporation of weekly changes in the USD index spot rate accounts for one of the major drivers of the activity of index traders who view commodity investment as a hedge against the USD depreciation (Gilbert, 2009; Gilbert, 2010b). These financial and macroeconomic variables are supposed to capture at least some fundamental supply and demand factors that may have an impact on price formation, and, thus, are supposed to mitigate the omitted variable bias that may impair the validity of the causal evidence (Gilbert, 2010b; Grosche, 2014). Table 4 summarizes the descriptive statistics for the control variables.

The lag structure $(n; m)$ is chosen by estimating Eq. (3) for different lag lengths that range from one to four and choosing the regression model that minimizes the Schwarz Bayesian information criterion.[5] The maximum number of four lags is reasonable given that weekly data are used. The optimal lag structure is $n = m = 1$ for all markets and both trader categories. As far as the lag number p for the control variables is concerned, it is chosen to be equal to the optimally chosen number of lags for the weekly growth in trader positions. This model specification eliminates the possibility that the coefficient estimates on positions are found to be statistically significant as a consequence of their correlation with macroeconomic and financial factors that Granger-cause commodity returns.

Newey-West standard errors are used if the Lagrange multiplier test indicates the presence of conditional heteroskedasticity. If the White test rejects the null hypothesis of homoskedasticity at ten percent significance level, heteroskedasticity-robust standard errors are used for the hypothesis testing. In the absence of any form of heteroskedasticity, OLS standard errors are used. To ensure that estimation results are not contaminated by collinearity issues, variance inflation factors are computed. Neither variance inflation factor exceeds the value of three and,

[4] The data are obtained from Datastream.
[5] For each of these estimations, the sample size is chosen such that the resulting ordinary least squares estimations are based on the same number of data points.

thus, is below the maximum acceptable threshold value of five that is commonly used as a benchmark.

As a next step, I explore Granger-causal effects from lagged positions to returns at a specified quantile range. The focus lies on tail quantiles $\theta = 0.05, 0.1, 0.9, 0.95$ and upper and lower parts of the return distribution $\theta = 0.25, 0.75$. The intermediate quantiles $\theta \in (0.25; 0.75)$ are not reported: The results obtained for these quantiles are similar to the OLS estimations. The model is specified as follows:

$$R_t = \alpha(\theta) + \sum_{i=1}^{n} \gamma_i(\theta) * R_{t-i} + \sum_{j=1}^{m} \beta_j(\theta) * S_{t-j} + \sum_{q=1}^{p} \delta_q^{CV}(\theta) * CV_{t-q} + \varepsilon_t \quad (8).$$

In this case, the focus lies on $\beta_j(\theta)$ that denotes the coefficient estimate on the lagged growth in net long trader positions in the regression specification related to the quantile θ of the return distribution. Granger causality at a particular quantile θ implies a statistical significance of the coefficient estimates $\beta_1(\theta), \dots, \beta_m(\theta)$.

The procedure for choosing the optimal lag structure for quantile regressions loosely follows Chuang et al. (2009). For reasons of simplicity, the optimal lag number on the return variable is set equal to the optimal lag order on the position and control variables: $n = m = p$. However, whereas Chuang et al. (2009) determine the optimal lag number for the total quantile range, I estimate the appropriate lag order at every individual quantile in order to account for the possibility that the lag order may change across quantiles. Thus, Eq. (8) is estimated at every individual quantile θ for $n = m = p = q$ beginning with $q = 1$. If $\beta_{q^*}(\theta)$ is significant, but $\beta_{q^*+1}(\theta)$ is not significant, then the optimal lag order is set equal to q^*. For all trader categories and all commodity markets, the optimal lag number q^* is constant across quantiles and is equal to one.

Two types of standard errors are used in estimations based on Eq. (8). Based on a Monte Carlo study, Buchinsky (1995) recommends the use of the pairs- (or design) bootstrapped standard errors for relatively small sample sizes. Moreover, the bootstrapped standard errors are valid under very general assumptions: They do not require either an identical sampling or independence between regressors and error terms. In addition, I report inference under the assumption that residuals are independent and identically distributed.

Robustness checks

Whereas scaling trader positions by open interest reflects the idea that it is the magnitude of positions relative to the total open interest that matters, the absolute magnitude of positions is also a common proxy for the trading activity (Grosche, 2014). Therefore, as a robustness check,

changes in net long positions scaled by open interest are substituted by unscaled changes in net long positions in Eq. (7) and (8). Unscaled net long positions are computed as the difference between long and short positions (in 100 thousands).

As an additional robustness check, Granger-causal effects of the lagged changes in scaled net long positions of index traders, money managers and other reportables are jointly estimated in the same regression specification both in the context of Granger causality in mean and Granger causality at the level of individual quantiles:

$$R_t = \alpha + \gamma_1 * R_{t-1} + \beta_1^{IT} * IT_{t-1} + \beta_1^{MM} * MM_{t-1} + \beta_1^{OR} * OR_{t-1} + \delta_1^{CV} * CV_{t-1} + \varepsilon_t \quad (9),$$

$$R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1^{IT}(\theta) * IT_{t-1} + \beta_1^{MM}(\theta) * MM_{t-1} + \beta_1^{OR}(\theta) * OR_{t-1} + \\ + \delta_1^{CV}(\theta) * CV_{t-1} + \varepsilon_t \quad (10).$$

IT_{t-1}, MM_{t-1} and OR_{t-1} denote the last week's changes in net long positions of index traders, money managers and other reportables, respectively. Net long positions are scaled by open interest. For reasons of simplicity, the lag structure is set to one for both trader categories and control variables CV. Control variables are weekly changes in the USD index spot rate, the S&P 500 index, the MSCI emerging markets index and the spot oil price.

Table 3 reports the correlations between IT_t, MM_t and OR_t in each of the twelve examined commodity markets. In most markets, the correlations of changes in net long positions of index traders with changes in net long positions of speculators (money managers and other reportables) are very low such that multicollinearity should not be an issue. Correlations between weekly changes in net long positions of money managers and other reportables are considerably higher. The results for coffee and SRW wheat markets should be treated with caution since the correlation between changes in net long positions of money managers and other reportables is relatively high (it amounts to -0.48).

Importantly, Eq. (9) and Eq. (10) are not contaminated by a potential cointegration between trader positions. Cointegration applies only to non-stationary series and there is no evidence that net long positions of all three trader categories (index traders, money managers and other reportables) are non-stationary in any market (Table 1).

Hedging pressure is an important determinant of futures returns (De Roon et al., 2000). In this case, disregarding changes in hedgers' positions may result in an omitted variable bias. However, correlations between net long positions of money managers and net short positions of hedgers HP (producers/merchants/processors/users) are very high (Table 3). Therefore, it is not

possible to include both trader categories in the same regression specification.[6] For other reportables and index traders, the following regression models are estimated:

$$R_t = \alpha + \gamma_1 * R_{t-1} + \beta_1^{IT} * IT_{t-1} + \beta_1^{OR} * OR_{t-1} + \beta_1^{HP} * HP_{t-1} + \delta_1^{CV} * CV_{t-1} + \varepsilon_t \quad (11),$$

$$R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1^{IT}(\theta) * IT_{t-1} + \beta_1^{OR}(\theta) * OR_{t-1} + \beta_1^{HP}(\theta) * HP_{t-1} + \\ + \delta_1^{CV}(\theta) * CV_{t-1} + \varepsilon_t \quad (12).$$

5 Results and Discussion

5.1 Granger Causality in Mean versus Granger Causality at Individual Quantiles

Table 5 reports the results for the Granger causality in mean, i.e. the coefficient estimates on the lagged changes in net long positions of traders. Tables 6-9 summarize the estimation results at individual quantiles for index traders, money managers and other reportables. Panel A reports the estimation results for the base model, i.e. Eq. (7) and (8) for changes in positions that are scaled by open interest. In Panel B, changes in unscaled net long positions are considered. Panel C shows the coefficient estimates on lagged position changes based on Eq. (9) and (10) where all three trader categories are included in the same regression specification. The coefficient estimates on lagged changes in net long positions of index traders and other reportables for Eq. (11) and (12) where the hedging pressure is included as an additional control variable can be found in Panel D.

For index traders, the null hypothesis of no Granger causality in mean from positions to subsequent futures returns can be rejected at five percent significance level only in the cocoa market (Table 5, Panels A, C and D). Significant Granger-causal effects from past changes in index traders' positions to cocoa returns can be observed in the upper part of the conditional return distribution at $\theta = 0.9$ for scaled position changes (Table 6, Panels A, C and D) and for changes in unscaled positions in the lower part of the return distribution at $\theta = 0.1$ (Table 6, Panel B). For corn, negative Granger-causal effects manifest themselves both in low and upper part of the conditional return distribution. In soybeans and sugar markets, there is also evidence of a negative and significant Granger causality from lagged index traders' positions to returns, but only when unscaled positions are considered (Table 6, Panel B).

Swap dealers are a trader category that is frequently used as a proxy for the activity of index traders in the existing research on agricultural futures markets (e.g. Brunetti and Buyuksahin, 2009; Irwin and Sanders, 2012b). Indeed, the correlations between changes in net long positions

[6] Otherwise, multicollinearity would arise.

of index traders and swap dealers are very high (Table 3). Table 7 reports the estimation results for swap dealers.[7] As has been confirmed for the positions of index traders, significant and robust Granger-causal effects from swap dealers' positions to returns exist at individual quantiles of the conditional return distribution in the corn market. Additionally, positive Granger-causal effects can be observed at $\theta = 0.95$ in the coffee market.

Significant and robust Granger causality in mean between returns and past growth in positions of money managers is detected for live cattle (Table 5, Panels A-C). Granger-causal relationships at individual quantiles corroborate the results of the Granger causality in mean: A significant relationship between changes in net long positions of money managers and subsequent returns arises in the upper part of the conditional return distribution in the live cattle market (Table 8). For coffee, there is robust evidence of negative Granger causality in mean, but this evidence is predominantly only marginally significant (Table 5). However, when individual quantiles are considered, significant Granger-causal effects from money managers' positions to returns can be observed at tail quantiles ($\theta = 0.95$) and in the lower part of the return distribution ($\theta = 0.25$) in the coffee market. In addition, significant Granger-causal effects of money managers on returns arise at individual quantiles in cocoa, feeder cattle, sugar and SRW wheat markets (Table 8).

For other reportables, significant Granger causality in mean can be observed only for lean hogs where significant Granger-causal effects also exist at individual quantiles (Tables 5 and 9). Robust Granger-causal effects from lagged positions of other reportables to returns arise in markets for coffee, SRW wheat and soybeans (only marginally significant) in the upper part of the conditional return distribution (Table 9).

In general, there is some evidence that the relationship between trader positions and returns is non-linear in different parts of the conditional return distribution in the sense that the sign of the slope coefficient $\beta_1(\theta)$ changes across different quantiles (e.g. soybeans in case of index traders, cocoa in case of money managers and SRW wheat in case of other reportables). In these cases, non-linearity may be one of the reasons why the null hypothesis of no Granger causality in mean cannot be rejected, but significant Granger-causal relationships exist at individual quantiles. Positive and negative $\beta_1(\theta)$ in different parts of the distribution may cancel each other out when the total distribution is considered. In general, in those cases where there is robust evidence of Granger causality in mean (e.g. the live cattle market for money managers and the lean hogs market for other reportables), almost no non-linearity at individual quantiles can be observed: The relationship between positions of traders and subsequent returns is

[7] Descriptive statistics on the net long positions of swap dealers can be found in Table 1.

negative almost at all quantiles considered, i.e. the sign on $\beta_1(\theta)$ does not change across quantiles in these markets.

As far as speculators are concerned, the results indicate that it makes sense to differentiate between money managers and other reportables instead of considering the non-commercial traders on an aggregate level. The existence of Granger-causal effects and the direction of Granger causality differ across markets. Only in the coffee market, both trader types appear to have a negative and significant Granger-causal effect on returns. By contrast, Granger-causal effects from past changes in net long positions to cocoa (SRW wheat) returns are negative (positive) for money managers and positive (negative) for other reportables.[8] Returns in the live cattle and sugar markets appear to be sensitive to positions of money managers, but not other reportables. The differences related to the potential price impact of other reportables and money managers are not surprising. As shown in Section 3, money managers and other reportables pursue different investment strategies, which may explain the divergent direction of Granger-causal effects of the two trader categories.

Importantly, the results on money managers are potentially contaminated by the omitted variable bias. Given the high correlation between positions of money managers and hedgers, it has not been possible to include the hedging pressure as one of the control variables. Table 10 summarizes the estimation results for Eq. (11) and (12) on the relationship between changes in net short positions of producers/merchants/producers/users and subsequent futures returns. The results are very similar to those on money managers: Significant Granger causality in mean arises in coffee and live cattle markets, whereas additional Granger-causal effects at individual quantiles are observed in markets for cocoa and sugar. The SRW wheat is the only market where there are significant Granger-causal effects at individual quantiles for money managers, but not for hedgers. Since it is not possible to infer which trader type (money managers or hedgers) triggers significant Granger-causal effects in the remaining markets, the results for money managers should be treated with caution.

5.2 Direction of Granger causality

Not only does the direction of Granger causality vary with trader categories, but also with markets within a single trader category. For instance, changes in net long positions of money

[8] Given the high negative correlation between positions of money managers and other reportables in the SRW wheat market (Table 3), it may be the case that only one trader category (either money managers or other reportables) forecasts the SRW wheat returns and that a significant coefficient estimate on changes in net long positions of another trader category (either money managers or other reportables) simply reflects this Granger causality. The estimation results shown in Panel C in Tables 8 and 9 where both trader categories are included may imply that it is the other reportables (and not money managers) that Granger-cause SRW wheat returns.

managers are associated with higher subsequent returns in sugar and SRW wheat markets, but appear to be related to lower subsequent returns in cocoa, coffee and live cattle markets. The impact of positions of other reportables on subsequent returns is, if significant, also heterogeneous across markets: It is positive for cocoa and corn and negative for coffee, lean hogs and SRW wheat. For index traders, the detected Granger causality from positions to returns is positive in the cocoa market and negative in the corn futures market. Whereas the positive slope coefficient on lagged changes in net long positions of traders is consistent with the notion that rising demand drives up prices, a negative coefficient should not be interpreted as a soothing impact on prices. Following Gebka and Wohar (2013), positive and negative slope coefficients β_1 and $\beta_1(\theta)$ can be interpreted in the context of fundamentally oriented trades and non-informational buying and selling.

In case of non-informational trades, prices may temporarily adjust to accommodate increases or decreases in net long positions of traders, but would quickly bounce back once market participants realize that non-informational trades are not related to the fundamental value of a commodity (e.g. Llorente et al., 2002; Gebka and Wohar, 2013). In this case, rising net long positions ($S_{t-1} \uparrow$) result in higher contemporaneous returns ($R_{t-1} \uparrow$), but prices in the following period t decline ($R_t \downarrow$) as the non-informational content of past changes in net long positions is recognized. Similarly, declining net long positions ($S_{t-1} \downarrow$) in $t-1$ may trigger negative contemporaneous returns ($R_{t-1} \downarrow$) and rising subsequent returns in t ($R_t \uparrow$) when prices revert to their fundamental values. In this case, a negative causality between changes in net long positions and subsequent futures returns is expected both at low and high quantiles of the conditional return distribution. The negative direction of Granger causality from trading activity to returns does not necessarily imply that trader positions trigger lower prices in the subsequent week, but indicates that increases in net long positions of index traders and speculators are associated with contemporaneous price increases that are reversed until the next Tuesday.

The case of non-informational trades is most likely to apply to index traders who typically do not take a view on individual commodities and adjust their positions for hedging and diversification purposes. Mayer (2009) argues that trading strategy of some money managers is based not on fundamentals, but on technical tools such as trend identification algorithms and investment rules that may include signals from other asset markets. In this case, money managers can be considered as noise traders whose activity is only partially related to fundamentals on commodity markets. Hence, some of the trades of money managers will be, at least partially, non-informational. Trading activity of other reportables may become non-informational, e.g. if they "copy" the trades of professional speculators such as money managers.

Rising net long positions that reflect positive private information about the fundamental value of a commodity in $t-1$ ($S_{t-1} \uparrow$) may result in higher contemporaneous returns ($R_{t-1} \uparrow$) and in rising subsequent futures returns ($R_t \uparrow$) as positive information disseminates in the market (e.g. Llorente et al., 2002; Gebka and Wohar, 2013). By contrast, a decline in net long positions in response to negative private information ($S_{t-1} \downarrow$) may trigger negative returns at time $t-1$ ($R_{t-1} \downarrow$) that are followed by further price declines at time t ($R_t \downarrow$) as negative information is absorbed by the market (Gebka and Wohar, 2013). Thus, in case of informational trades, a positive relationship between net long positions S_{t-1} and returns R_t is expected both at high and low quantiles that are associated with positive and negative returns, respectively. This case is more likely to apply to money managers who, as professional speculators, are most likely to conduct research on individual commodities and trade on discovered information.

Importantly, the direction of the serial return correlation, i.e. the relationship between the consecutive returns R_t and R_{t-1} in regression specifications that include a single trader category (Eq. 8), may also provide valuable insight into the information content of trading: Non-informational trades should be associated with subsequent price reversals, whereas return continuations are expected in case of informational trades (Llorente et al., 2002). A negative sign of the serial return correlation and of the Granger-causal relationship between lagged changes in net long positions and returns may indicate the non-informational content of trades and that the associated price effects are only temporary and are followed by price reversals. By contrast, a positive direction of both the serial return correlation and the Granger-causal relationship between lagged changes in net long positions and returns may imply that price effects associated with a certain trader category may become persistent, i.e. prevail until the next Tuesday. In most cases, my results are consistent with these predictions: Trading activity-return causality and the return autocorrelation have the same sign in those cases where significant Granger causality from lagged changes in positions to returns is detected. Only for money managers in cocoa and feeder cattle markets, other reportables in the coffee market and index traders in the cocoa market, I obtain opposite signs of the coefficient estimates on the lagged return and position variables. However, the coefficient estimates on the lagged return variables are insignificant.[9]

An important limitation of the framework presented above is the weekly frequency of the data.[10] It is unlikely that liquid markets take one week to re-adjust to non-informational trades. In this case, it may be misleading to expect rising/declining subsequent returns over a period of one

[9] The results on the coefficient estimates on the lagged return variables are available on demand.
[10] The CFTC publishes the data on trader positions only at weekly frequency. Daily data are not publicly available.

week as a result of informed trades on positive/negative fundamentals in liquid markets. Accounting for non-informational and informational changes in positions of traders that trigger price effects that persist for a week or longer may reconcile the framework of Gebka and Wohar (2013) to the weekly temporal aggregation of the data.

Non-informational trades may be misinterpreted as valuable private information by other market participants (e.g. noise traders, less informed traders) who imitate these trades and, thus, further exacerbate the price effects. Similarly, fundamentally based trades of speculators may be copied by less informed investors such that the initial price effects will be amplified. Alternatively, rational speculators may purposely destabilize the price mechanism in order to trigger positive feedback trading (Tokic, 2012).[11] If the triggered positive feedback trading is sufficiently strong, rational arbitrageurs may not be able to quickly correct the mispricing that arises as a consequence of non-informational trades. Therefore, it may take one week or more to re-adjust to non-informational trades and bring prices back to their fundamental values. If the triggered positive feedback trading of other market participants is not strong enough and the re-adjustment takes place within a week, we should expect a negative Granger causality from position changes in $t-1$ to returns in t. If the price effects triggered by trades of speculators become persistent,[12] a positive causality between S_{t-1} and R_t would result.

In the scenario described above, a lot of emphasis is laid on the assumption that trades of index traders and speculators (money managers and other reportables) are either imitated by less informed traders or have the potential to trigger positive feedback trading. In this respect, Jickling and Austin (2011) argue that money managers are perceived as especially capable of achieving superior performance and identifying new information. In this case, their trades may be most likely to be copied by other short-term traders such that the propagation of private information inherent in the trades of money managers may become persistent. It is, however, arguable whether speculators purposely destabilize prices by initiating trades in the hope of triggering positive feedback trading and, then, selling their initial positions at profit as suggested by Tokic (2012). Table 2 shows that money managers are positive feedback traders in all examined markets: They increase their demand in response to rising prices. By contrast, there is evidence of a negative feedback trading in several markets for other reportables.

[11] By buying an asset, rational speculators may hope to create an artificial trend of rising prices that would attract positive feedback of other traders who reinforce the trend and further inflate futures prices (Tokic, 2012). Then, an investor makes profits by selling his initial position (Tokic, 2012).

[12] De Long et al. (1990) show that prices may persistently deviate from their fundamental values in the presence of noise traders who impose a limit to arbitrage. Given the unpredictability of the noise traders' behavior, risk-averse rational investors are less likely to engage in arbitrage: If noise traders continue to trade on their beliefs and e.g. imitate the trades of speculators, mispricing may become even more extreme and arbitrageurs would incur losses when they liquidate their investment in a mispriced asset (De Long et al., 1990).

One should be cautious while drawing conclusions about the information content of trades based on the sign of the observed Granger-causal relationship on a weekly basis. For instance, a positive sign may indicate both fundamentally based and non-informational trades that trigger a sufficiently strong positive feedback trading of other market participants such that the price effects are not arbitraged away within a week. Whereas a positive sign of the Granger-causal relationship from trading activity to returns may be an indication that rising net long positions of a particular trader category have the potential to increase prices over a period of the next seven days, a negative sign implies that rising net long positions may have triggered contemporaneous price increases and perhaps also rising prices in the next few days that, however, disappear until the next Tuesday.

Most significant Granger-causal effects are observed in the upper part of the conditional return distribution (e.g. coffee, SRW wheat and soybeans for other reportables; feeder cattle, SRW wheat and sugar for money managers; cocoa for index traders). In this case, a positive sign may indicate that increases in net long positions are associated with rising prices within the next days. By contrast, a negative slope coefficient observed at upper quantiles of the return distribution may imply that price reversals are linked to falling net long positions: Tuesday's decreases in net long positions may trigger contemporaneous price declines and falling prices in the next few days, but the next Tuesday's prices increase as the non-informational content of the position changes is realized.

6 Conclusion

This paper examines the information content of trading activity of speculators and commodity index traders in agricultural futures markets. Whereas the existing research on the price impact of these trader categories predominantly relies on Granger causality in mean, this study resorts to quantile regressions in order to examine Granger causality in different parts of the return distribution. Quantile regressions allow accounting for non-linearity in the relationship between positions of traders and futures returns. This study shows that there are significant Granger-causal effects from positions to returns that would not have been unveiled while using the traditional OLS approach. There is robust evidence of Granger causality in mean from positions to returns for money managers in coffee and live cattle markets, for other reportables in the lean hogs market and for index traders in the cocoa market. Quantile regressions uncover significant Granger-causal effects from positions to returns at individual quantiles even in those markets where no Granger causality in mean is detected. This is the case for index traders in the corn market, for money managers in the cocoa, feeder cattle, sugar and SRW wheat markets as well as for other reportables in coffee, cocoa, SRW wheat and soybeans markets.

In terms of policy implications, one should be cautious while interpreting the detected Granger-causal effects as price impact. Whereas significant coefficients on past changes in net positions of speculators and index traders indicate that trader positions are useful in forecasting futures returns, they cannot be interpreted as *prima facie* causal evidence of a price impact (Grosche, 2014). To deal with the omitted variable bias, control variables have been introduced that ensure that the significance of coefficient estimates does not arise as a result of omitted relevant macroeconomic or financial variables. However, it has not been possible to include important fundamentals such as inventory and storage costs since these data are not available on a weekly basis. Hedging pressure is an important determinant of futures returns (De Roon et al., 2000). This effect has been accounted for in estimations related to index traders and other reportables. However, given that changes in net positions of hedgers and money managers display very high correlations with each other, including positions of both trader groups in the same regression specification has not been possible due to multicollinearity. Therefore, while interpreting the results, it should be borne in mind that e.g. a significant coefficient estimate on the lagged change in net long positions of money managers may simply reflect significant Granger-causal effects of hedgers' positions on returns.

This study relies on a comparatively low frequency (weekly) data. Therefore, the absence of significant Granger-causal effects either in mean or at individual quantiles in markets such as cotton, HRW wheat and soybean oil should not be interpreted as evidence that trader positions do not have any price impact in these markets. According to both the market microstructure theory and the "efficient markets" hypothesis, an impact of lagged position changes on the next week's returns is unlikely to manifest itself (Gilbert and Pfuderer, 2014). Moreover, the CFTC data are highly aggregated across heterogeneous traders within a single trader category and different contract maturities. Combining the quantile analysis with (not publicly available) daily data may yield more convincing results with respect to the potential of speculators and index traders to influence the price mechanism in commodity markets.

References

Abbott, P.C., Hurt, C., Tyner, W.E. (2011). What is driving food prices in 2011? Farm foundation issue report. Accessed July 2015, available at: http://www.farmfoundation.org/news/articlefiles/1742-FoodPrices_web.pdf.

Adämmer, P., Bohl, M.T. (2015). Speculative bubbles in agricultural prices. The Quarterly Review of Economics and Finance, 55, 67-76.

Aulerich, N.M., Irwin, S.H., Garcia, P. (2013). Bubbles, food prices, and speculation: Evidence from the CFTC's daily larger trader data files. NBER Working Paper. Accessed July 2015, available at: http://www.nber.org/papers/w19065.

Bohl, M.T, Stephan, P.M. (2013). Does futures speculation destabilize spot prices? New evidence for commodity markets. Journal of Agricultural and Applied Economics, 45, 595-616.

Borin, A., Di Nino, V. (2012). The role of financial investments in agricultural commodity derivatives markets. Banca D'Italia Working Paper 849. Accessed July 2015, available at: http://www.bancaditalia.it/pubblicazioni/temi-discussione/2012/2012-0849/en_tema_849.pdf.

Brunetti, C., Buyuksahin, B. (2009). Is speculation destabilizing? SSRN Working Paper. Accessed July 2015, available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1393524.

Brunetti, C., Buyuksahin, B., Harris, J.H. (2011a). Speculators, prices and market volatility. SSRN Working Paper. Accessed July 2015, available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1736737.

Brunetti, C., Buyuksahin, B., Harris, J.H. (2011b). Do institutional traders predict bull and bear markets? SSRN Working Paper. Accessed July 2015, available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1930197.

Brunetti, C., Reiffen, D. (2014). Commodity index trading and hedging costs. Journal of Financial Markets, 21, 153-180.

Buchinsky, M. (1995). Estimating the asymptotic covariance matrix for quantile regression models. A Monte Carlo study. Journal of Econometrics, 68, 303-338.

Buchinsky, M. (1998a). The dynamics of changes in the female wage distribution in the USA: A quantile regression approach. Journal of Applied Econometrics, 13, 1-30.

Buchinsky, M. (1998b). Recent advances in quantile regression models: A practical guideline for empirical research. Journal of Human Resources, 33, 88-126.

Buyuksahin, B., Harris, J.H. (2011). Do speculators drive crude oil futures prices? Energy Journal, 32, 167-202.

Capelle-Blancard, G., Coulibaly, D. (2011). Index trading and agricultural commodity prices: A panel Granger causality analysis. Economie Internationale (International Economics), 126-127, 51-72.

Carchano, O., Pardo, A. (2009). Rolling over stock index futures contracts. The Journal of Futures Markets, 29, 684-694.

Chuang, C-C., Kuan, C-M., Lin, H-Y. (2009). Causality in quantiles and dynamic stock return-volume relations. Journal of Banking and Finance, 33, 1351-1360.

CFTC (2006). Commission actions in response to the "Comprehensive review of the Commitments of Traders reporting program". Accessed July 2015, available at: http://www.cftc.gov/files/cftc/cftcnoticeonsupplementalcotreport.pdf.

CFTC (2008). Staff report on commodity swap dealers and index traders with commission recommendations. Accessed July 2015, available at:
http://www.loe.org/images/content/080919/cftcstaffreportonswapdealers09.pdf.

CFTC (2009). Disaggregated commitments of trader reports: Explanatory notes. Accessed July 2015, available at:
http://www.cftc.gov/ucm/groups/public/@commitmentsoftraders/documents/file/disaggregatedcotexplanatorynot.pdf.

CFTC (2013). Position limits for derivatives. Federal Register 78. Accessed July 2015, available at:
http://www.cftc.gov/ucm/groups/public/@lrfederalregister/documents/file/2013-27200a.pdf.

Cooke, B., Robles, M. (2009). Recent food price movements: a time-series analysis. IFPRI Discussion Paper No. 00942. Accessed July 2015, available at:
http://www.ifpri.org/sites/default/files/publications/ifpridp00942.pdf.

De Long, J.B., Shleifer, A., Summers, L.H., Waldmann, R.J. (1990). Noise trader risk in financial markets. Journal of Political Economy, 98, 703-738.

De Roon, F.A., Nijman, T.E., Veld, C. (2000). Hedging pressure effects in futures markets. The Journal of Finance, 55, 1437-1456.

Etienne, X.L., Irwin, S.H., Garcia, P. (2014). Bubbles in food commodity markets: Four decades of evidence. Journal of International Money and Finance, 42, 129-155.

Fattouh, B., Scaramozzino, P., Harris, L. (2005). Capital structure in South Korea: A quantile regression approach. Journal of Development Economics, 76, 231-250.

Fische, R.P.H., Janzen, J.P., Smith, A. (2014). Hedging and speculative trading in agricultural futures markets. American Journal of Agricultural Economics, 96, 542-556.

Garcia, J., Hernandez, P.J., Lopez-Nicolas, A. (2001). How wide is the gap? An investigation of gender wage differences using quantile regression. Empirical Economics, 26, 149-167.

Gao, L., Liu, L. (2014). The volatility behavior and dependence structure of commodity futures and stocks. The Journal of Futures Markets, 34, 93-101.

Gebka, W., Wohar, M. (2013). Causality between trading volume and returns: Evidence from quantile regressions. International Review of Economics and Finance, 27, 144-159.

Gilbert, C.L. (2009). Speculative influences on commodity futures prices 2006-2008. Working Paper. Accessed July 2015, available at:
http://www.cftc.gov/ucm/groups/public/@swaps/documents/file/plstudy_14_cifrem.pdf.
Gilbert, C.L. (2010a). How to understand high food prices. Journal of Agricultural Economics, 61, 398- 425.
Gilbert, C.L. (2010b). Speculative influences on commodity futures prices 2006-2009. United Nations Conference on Trade and Development Discussion Paper No. 197. Accessed July 2015, available at:
http://unctad.org/en/docs/osgdp20101_en.pdf.
Gilbert, C.L., Pfuderer, S. (2014). The role of index trading in the price formation in the grains and oilseeds markets. Journal of Agricultural Economics, 65, 303-322.
Goel, R.K., Ram, R. (2004). Quantile-regression estimates of cigarette demand elasticities for the United States. Journal of Economics and Finance, 28, 413-421.
Granger, C.W.J. (1980). Testing for causality: a personal viewpoint. Journal of Economic Dynamics and Control, 2, 329-352.
Grosche, S.-C. (2014). What does Granger causality prove? A critical examination of the interpretation of Granger causality results on price effects of index trading in the agricultural commodity markets. Journal of Agricultural Economics, 65, 279-302.
Guttierrez, L. (2013). Speculative bubbles in agricultural commodity markets. European Review of Agricultural Economics, 40, 217-238.
Hamilton, J.D. (1994). Time Series Analysis. Princeton University Press, Princeton, NJ.
Hamilton, J.D., Wu, J.C. (2014). Effects of index-fund investing on commodity futures prices. NBER Working Paper No. 19892. Accessed July 2015, available at:
http://www.nber.org/papers/w19892.
Irwin, S.H. (2013). Commodity index investment and food prices: Does the "Masters Hypothesis" explain recent price spikes? Agricultural Economics, 44, 29-41.
Irwin, S.H., Sanders, D.R. (2011). Index funds, financialization, and commodity futures markets. Applied Economic Perspectives and Policy, 33, 1-31.
Irwin, S.H., Sanders, D.R. (2012a). Testing the Masters hypothesis in commodity futures markets. Energy Economics, 34, 256-269.
Irwin, S.H., Sanders, D.R. (2012b). Financialization and structural change in commodity futures markets. Journal of Agricultural and Applied Economics, 44, 371-396.
Irwin, S.H., Sanders, D.R., Merrin, R.P. (2009). Devil or angel? The role of speculation in the recent commodity price boom (and bust). Journal of Agricultural and Applied Economics, 41, 377-391.

Jickling, M., Austin, D.A. (2011). Hedge fund speculation and oil prices. CRS report for congress. Accessed July 2015, available at: http://fas.org/sgp/crs/misc/R41902.pdf.

Koenker, R., Hallock, K.F. (2001). Quantile regression. Journal of Economic Perspectives, 15, 143-156.

Kuralbayeva, K., Malone, S. (2012). The determinants of extreme commodity prices. OxCarre Research Paper 96. Accessed July 2015, available at:
http://www.oxcarre.ox.ac.uk/files/OxCarreRP201296.pdf.

Lee, T.-H., Yang, W. (2012). Money-income Granger-causality in quantiles. Advanced Econometrics, 30, 385-407.

Llorente, G., Michaely, R., Saar, G., Wang, J. (2002). Dynamic volume-return relation of individual stocks. The Review of Financial Studies, 15, 1005-1047.

Manera, M., Nicolini, M., Vignati, I. (2012). Returns in commodities futures markets and financial speculation: A multivariate GARCH approach. SSRN Working Paper. Accessed July 2014, available at:
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2041177.

Mayer, J. (2009). The growing interdependence between financial and commodity markets. United Nations Conference on Trade and Development Discussion Paper No. 195. Accessed July 2015, available at: http://unctad.org/en/Docs/osgdp20093_en.pdf.

Mayer, J. (2012). The growing financialisation of commodity markets: Divergences between index investors and money managers. Journal of Development Studies, 48, 751-767.

Mensi, W., Beljid, M., Boubaker, A., Managi, S. (2013). Correlations and volatility spillovers across commodity and stock markets: Linking energies, food and gold. Economic Modelling, 32, 15-22.

Mitchell, D. 2008. A note on rising food prices. Policy Research Working Paper No. 4682. Accessed July 2015, available at:
https://openknowledge.worldbank.org/bitstream/handle/10986/6820/WP4682.pdf.

Mou, Y. (2011). Limits to arbitrage and commodity index investment: Front-running the Goldman roll. Columbia University Working Paper. Accessed July 2015, available at:
http://www.cftc.gov/ucm/groups/public/@swaps/documents/file/plstudy_33_yu.pdf.

Sanders, D.R., Irwin, S.H. (2010). A speculative bubble in commodity futures prices? Cross-sectional evidence. Agricultural Economics, 41, 25-32.

Sanders, D.R., Irwin, S.H. (2011). New evidence on the impact of index funds in U.S. grain futures markets. Canadian Journal of Agricultural Economics, 59, 519-532.

Silvennoinen, A., Thorp, S. (2013). Financialization, crisis and commodity correlation dynamics. Journal of International Financial Markets, Institutions and Money, 24, 24-65.

Singleton, K.J. (2014). Investor flows and the 2008 boom/bust in oil prices. Management Science, 60, 300-318.

Stoll, H.R., Whaley, R.E. (2011). Commodity index investing: Speculation or diversification? Journal of Alternative Investments, 14, 50-60.

Tang, K., Xiong, W. (2012). Index investment and the financialization of commodities. Financial Analysts Journal, 68, 54-74.

Tokic, D. (2012). Speculation and the 2008 oil buble: The DCOT Report analysis. Energy Policy, 45, 541-550.

Appendix

Table 1: Descriptive statistics

Panel A: Index traders and swap dealers

	Index traders				Swap dealers			
	Mean (level)	Std/ mean (level)	ADF (level)	ADF (change)	Mean (level)	Std/ mean (level)	ADF (level)	ADF (change)
Cocoa	0.15	0.26	-3.46***	-15.76***	0.06	0.47	-2.87**	-18.31***
Coffee	0.25	0.20	-3.13**	-5.14***	0.25	0.21	-2.99**	-15.86***
Corn	0.22	0.18	-3.01**	-4.97***	0.24	0.23	-2.42	-14.67***
Cotton	0.28	0.24	-3.83***	-16.72***	0.31	0.27	-3.07**	-12.07***
Feeder cattle	0.21	0.27	-3.05**	-17.60***	0.13	0.29	-3.73***	-15.82***
Live cattle	0.34	0.17	-1.85	-5.78***	0.32	0.16	-1.69	-17.89***
Lean hogs	0.37	0.19	-1.73	-20.49***	0.33	0.20	-1.65	-19.13***
Sugar	0.24	0.24	-2.73*	-17.48***	0.15	0.64	-1.92	-15.35***
SRW wheat	0.36	0.14	-4.45***	-18.24***	0.35	0.16	-2.36	-15.82***
HRW wheat	0.24	0.25	-2.59*	-18.12***	0.19	0.27	-2.55	-17.11***
Soybeans	0.22	0.23	-1.88	-5.08***	0.22	0.32	-1.45	-13.24***
Soybean oil	0.24	0.16	-4.29***	-14.08***	0.24	0.17	-3.38**	-17.65***

Panel B: Money managers and other reportables (traditional speculators)

	Money managers				Other reportables			
	Mean (level)	Std/ mean (level)	ADF (level)	ADF (change)	Mean (level)	Std/ mean (level)	ADF (level)	ADF (change)
Cocoa	0.15	0.88	-3.01**	-13.21***	0.01	1.66	-3.77***	-13.21***
Coffee	0.04	3.07	-3.57***	-13.81***	0.04	0.81	-3.80***	-13.81***
Corn	0.12	0.65	-2.93**	-15.11***	0.04	0.75	-2.23	-15.11***
Cotton	0.10	1.25	-3.41***	-12.43***	0.01	5.91	-3.56***	-12.43***
Feeder cattle	0.18	0.73	-3.80***	-13.63***	-0.05	1.25	-3.41**	-13.63***
Live cattle	0.15	0.59	-2.47	-13.82***	-0.04	0.94	-3.37**	-13.82***
Lean hogs	0.09	1.18	-3.01**	-14.04***	-0.02	2.22	-2.86*	-14.04***
Sugar	0.10	0.81	-2.97**	-14.48***	0.03	0.90	-3.18**	-14.48***
SRW wheat	0.01	7.22	-3.60***	-15.81***	-0.03	0.85	-3.69***	-15.81***
HRW wheat	0.15	0.62	-3.81***	-13.45***	0.05	0.80	-2.96**	-13.45***
Soybeans	0.16	0.53	-4.08***	-15.65***	0.03	1.29	-2.85*	-15.65***
Soybean oil	0.06	1.87	-3.59***	-14.22***	0.01	3.04	-4.35***	-14.22***

Panel C: Futures returns

	Mean	Std	ADF
Cocoa	0.0004	0.04	-20.23***
Coffee	-0.0019	0.04	-20.65***
Corn	0.0005	0.05	-21.37***
Cotton	-0.0006	0.04	-19.17***
Feeder cattle	-0.0007	0.02	-20.44***
Live cattle	-0.0013	0.02	-22.41***
Lean hogs	-0.0031	0.03	-21.14***
Sugar	-0.0011	0.05	-21.32***
SRW wheat	-0.0016	0.05	-20.46***
HRW wheat	-0.0006	0.04	-20.20***
Soybeans	0.0019	0.04	-20.25***
Soybean oil	0.0000	0.04	-20.01***

Note: Table 1 reports the mean, standardized standard deviation (standard deviation scaled by mean) and the test statistic of the Augmented Dickey Fuller test on unit root for levels and changes in net long positions (scaled by open interest) of index traders, swap dealers, money managers and other reportables. Panel C reports the mean, standard deviation and the test statistic of the Augmented Dickey-Fuller test for returns in the examined commodity futures markets. The estimations are based on the period from January 10, 2006 to December 31, 2013 (June 20, 2006 to December 31, 2013) for positions of index traders and returns (for positions of other reportables and money managers).

***, ** and * denote the rejection of the null hypothesis of the Augmented Dickey Fuller test on unit root at one, five and ten percent, respectively.

Table 2: Granger causality in mean from returns to positions

	Cocoa	Coffee	Corn	Cotton	Feeder cattle	Live cattle	Lean hogs	Sugar	SRW wheat	HRW wheat	Soybeans	Soybean oil
Index traders	-0.01	-0.01	-0.01	-0.05**	-0.04	-0.01	-0.04**	-0.02*	-0.01	0.02	-0.003	-0.03
	(0.01)	(0.02)	(0.01)	(0.02)	(0.04)	(0.03)	(0.02)	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)
Money managers	0.18***	0.27***	0.09***	0.08**	0.61***	0.36***	0.17***	0.06***	0.09***	0.13***	0.12***	0.19***
	(0.03)	(0.05)	(0.03)	(0.04)	(0.08)	(0.06)	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)	(0.05)
Other reportables	-0.03***	-0.08***	-0.01	-0.03	0.01	-0.11***	-0.02	-0.02**	-0.03***	-0.02	0.00	-0.05***
	(0.01)	(0.02)	(0.01)	(0.02)	(0.05)	(0.03)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)

Note: Table 2 shows the slope coefficient β_1 on the lagged return R_{t-1} in the regression specification $S_t = \alpha + \gamma_1 * S_{t-1} + \beta_1 * R_{t-1} + \delta_1^{CV} * CV_{t-1} + \varepsilon_t$. The dependent variable is the weekly change in net trader positions S_t that is regressed on lagged position changes S_{t-1}, lagged return R_{t-1} and lagged control variables CV_{t-1}. Control variables are weekly changes in the spot oil price, MSCI emerging markets index, USD index spot rate and S&P 500 index. This estimation is conducted separately for index traders, money managers and other reportables in each of the twelve commodity markets. For index traders, the estimation period ranges from January 10, 2006 to December 31, 2013. For money managers and other reportables, the estimations cover the period from June 13, 2006 to December 31, 2013.

Standard errors are reported below the coefficient estimates in parentheses. Newey-West standard errors are used for money managers in cocoa, corn, cotton and soybeans markets; for other reportables in markets for cocoa, feeder cattle, lean hogs and sugar; for index traders in cocoa, feeder cattle and sugar markets. White standard errors are used in the regression specification related to index traders in the market for lean hogs. In the remaining estimations, there is no evidence of either heteroskedasticity or conditional heteroskedasticity and the OLS standard errors are used.

***, ** and * denote significance at one, five and ten percent, respectively.

Table 3: Correlations between net positions of different trader categories

	MM&OR	MM&IT	OR&IT	MM&HP	OR&HP	IT&HP	SW&IT	SW&MM	SW&OR	SW&HP
Cocoa	-0.35	-0.01	-0.01	0.87	-0.08	0.16	0.54	-0.12	0.00	0.19
Coffee	-0.48	-0.07	-0.10	0.86	-0.20	0.19	0.77	-0.09	-0.02	0.28
Corn	-0.20	-0.05	-0.03	0.84	0.13	0.23	0.79	-0.05	-0.12	0.29
Cotton	-0.27	-0.12	0.10	0.79	0.12	0.28	0.77	-0.07	-0.02	0.38
Feeder cattle	-0.32	0.02	-0.06	0.69	0.15	0.18	0.79	-0.07	-0.08	0.18
Live cattle	-0.31	-0.02	0.09	0.77	0.18	0.31	0.79	-0.04	-0.04	0.30
Lean hogs	-0.31	-0.17	-0.13	0.70	0.16	0.22	0.90	-0.27	-0.14	0.14
Sugar	-0.28	-0.02	-0.03	0.78	0.02	0.31	0.78	-0.04	-0.05	0.42
SRW wheat	-0.48	-0.01	-0.19	0.84	-0.28	0.30	0.77	-0.03	-0.30	0.35
HRW wheat	-0.18	0.17	-0.02	0.84	0.14	0.40	0.85	0.08	-0.06	0.34
Soybeans	-0.22	0.00	-0.32	0.87	0.07	0.17	0.83	-0.04	-0.24	0.22
Soybean oil	-0.25	-0.05	-0.14	0.87	0.01	0.17	0.74	-0.03	-0.15	0.27

Note: Table 3 shows correlations between weekly changes in positions of index traders (IT), money managers (MM), other reportables (OR), swap dealers (SW) and hedgers (HP). For index traders, swap dealers, money managers and other reportables net long positions are considered, whereas for hedgers (i.e. producers/merchants/processors/users) net short positions are used. All positions are scaled by open interest.

Table 4: Descriptive statistics (control variables)

	Mean	Std	ADF test (t-stat)
S&P 500 Composite Price Index	0.0009	0.03	-21.54***
USD Index Spot Rate (trade-weighted)	-0.0003	0.01	-20.44***
MSCI Emerging Market Index	0.0008	0.04	-21.45***
Crude Oil-WTI Spot Cushing Price	0.0011	0.05	-21.87***

Note: Table 4 reports the descriptive statistics (mean, standard deviation and the t-statistic of the Augmented Dickey Fuller test on unit root) for weekly changes in control variables included in all regression specifications. The data are drawn from Datastream. Weekly changes are computed as natural logarithms. The sample period ranges from January 10, 2006 to December 31, 2013.
***, **, * denote the rejection of the null hypothesis of the unit root at one, five and ten percent, respectively.

Table 5: Granger causality in mean

	COCOA	COFFEE	CORN	COTTON	FEEDER CATTLE	LIVE CATTLE	LEAN HOGS	SUGAR	SRW WHEAT	HRW WHEAT	SOYBEANS	SOYBEAN OIL
Panel A: Granger causality from changes in net long positions (scaled by open interest) to returns:												
Index traders: $R_t = \alpha + \gamma_1 * R_{t-1} + \beta_1 * IT_{t-1} + \delta_1^{CV} * CV_{t-1} + \varepsilon_t$												
β_1:	0.46**	-0.02	-0.34	-0.12	-0.08	0.12	-0.03	0.27	-0.07	-0.01	0.15	0.18
	(0.23)	(0.13)	(0.21)	(0.13)	(0.08)	(0.07)	(0.11)	(0.21)	(0.14)	(0.18)	(0.20)	(0.12)
Money managers: $R_t = \alpha + \gamma_1 * R_{t-1} + \beta_1 * MM_{t-1} + \delta_1^{CV} * CV_{t-1} + \varepsilon_t$												
β_1:	-0.12	-0.14*	0.03	-0.05	-0.02	-0.11***	-0.02	0.13	0.10	0.06	0.001	0.01
	(0.12)	(0.08)	(0.13)	(0.07)	(0.03)	(0.04)	(0.08)	(0.14)	(0.12)	(0.09)	(0.09)	(0.06)
Other reportables: : $R_t = \alpha + \gamma_1 * R_{t-1} + \beta_1 * OR_{t-1} + \delta_1^{CV} * CV_{t-1} + \varepsilon_t$												
β_1:	0.32	-0.24	0.24	0.03	0.08	-0.08	-0.34***	-0.07	-0.08	0.15	-0.20	-0.02
	(0.26)	(0.18)	(0.32)	(0.14)	(0.06)	(0.08)	(0.13)	(0.33)	(0.25)	(0.18)	(0.22)	(0.13)
Panel B: Granger causality from changes in unscaled net long positions to returns:												
Index traders: $R_t = \alpha + \gamma_1 * R_{t-1} + \beta_1 * IT_{t-1} + \delta_1^{CV} * CV_{t-1} + \varepsilon_t$												
β_1:	0.21	-0.06	-0.06*	0.09	-0.11	0.02	0.01	-0.02	-0.04	0.14	0.002	0.10
	(0.18)	(0.17)	(0.03)	(0.15)	(0.28)	(0.05)	(0.08)	(0.04)	(0.05)	(0.12)	(0.06)	(0.07)
Money managers: $R_t = \alpha + \gamma_1 * R_{t-1} + \beta_1 * MM_{t-1} + \delta_1^{CV} * CV_{t-1} + \varepsilon_t$												
β_1:	-0.12	-0.10*	0.004	-0.01	-0.05	-0.03**	-0.01	0.02	0.02	0.01	0.01	0.001
	(0.06)	(0.06)	(0.01)	(0.04)	(0.09)	(0.01)	(0.04)	(0.02)	(0.03)	(0.07)	(0.07)	(0.02)
Other reportables: : $R_t = \alpha + \gamma_1 * R_{t-1} + \beta_1 * OR_{t-1} + \delta_1^{CV} * CV_{t-1} + \varepsilon_t$												
β_1:	0.17	-0.18	0.02	0.01	0.25	-0.02	-0.16**	-0.02	-0.03	0.09	-0.03	-0.01
	(0.16)	(0.13)	(0.02)	(0.08)	(0.18)	(0.03)	(0.06)	(0.04)	(0.06)	(0.14)	(0.04)	(0.04)

Table 5 (continued): Granger causality in mean

	COCOA	COFFEE	CORN	COTTON	FEEDER CATTLE	LIVE CATTLE	LEAN HOGS	SUGAR	SRW WHEAT	HRW WHEAT	SOYBEANS	SOYBEAN OIL
Panel C: Granger causality from changes in net long positions (scaled by open interest) to returns; index traders, money managers and other reportables included in the same regression:												
$R_t = \alpha + \gamma_1 * R_{t-1} + \beta_1^{IT} * IT_{t-1} + \beta_1^{MM} * MM_{t-1} + \beta_1^{OR} * OR_{t-1} + \delta_1^{CV} * CV_{t-1} + \varepsilon_t$												
β_1^{IT}:	0.46**	-0.05	-0.32	-0.11	-0.08	0.16**	-0.07	0.26	-0.06	-0.01	0.15	0.20
	(0.23)	(0.14)	(0.21)	(0.34)	(0.08)	(0.07)	(0.12)	(0.21)	(0.15)	(0.19)	(0.22)	(0.25)
β_1^{MM}:	-0.08	-0.25***	0.06	-0.06	0.001	-0.15***	-0.11	0.11	0.10	0.07	-0.02	-0.01
	(0.09)	(0.09)	(0.14)	(0.07)	(0.03)	(0.04)	(0.09)	(0.14)	(0.13)	(0.10)	(0.10)	(0.10)
β_1^{OR}:	0.23	-0.54**	0.27	0.01	0.08	-0.18**	-0.40***	0.01	-0.004	0.18	-0.15	0.03
	(0.27)	(0.21)	(0.33)	(0.16)	(0.06)	(0.08)	(0.14)	(0.33)	(0.28)	(0.19)	(0.25)	(0.25)
Panel D: Granger causality from changes in net long positions (scaled by open interest) to returns; index traders, other reportables and hedgers included in the same regression:												
$R_t = \alpha + \gamma_1 * R_{t-1} + \beta_1^{IT} * IT_{t-1} + \beta_1^{OR} * OR_{t-1} + \beta_1^{HP} * HP_{t-1} + \delta_1^{CV} * CV_{t-1} + \varepsilon_t$												
β_1^{IT}:	0.52**	0.05	-0.40	-0.08	-0.09	0.24***	0.01	0.16	-0.10	-0.08	0.19	0.18
	(0.23)	(0.14)	(0.25)	(0.14)	(0.06)	(0.08)	(0.12)	(0.24)	(0.17)	(0.20)	(0.22)	(0.13)
β_1^{OR}:	0.32	-0.28	0.19	0.05	0.07	-0.05	-0.30**	-0.09	-0.08	0.09	-0.12	0.01
	(0.25)	(0.19)	(0.31)	(0.14)	(0.06)	(0.08)	(0.13)	(0.33)	(0.25)	(0.18)	(0.24)	(0.13)

Note: Table 5 shows the coefficient estimate on lagged changes in net long positions of traders (Eq. (7) for Panels A and B, Eq. (9) for Panel C and Eq. (11) for Panel D). In Panels A, C and D, changes in net long positions are scaled by open interest, whereas in Panel B changes in unscaled net long positions (in 100 thousands) are considered. For index traders in Panels A and B, the estimation period begins on January 10, 2006. In the remaining specifications, the estimations are based on weekly observations from June 20, 2006 to December 31, 2013. Standard errors are reported below the coefficient estimates in parentheses. OLS standard errors are used in cocoa, coffee and lean hogs markets. White standard errors are used in feeder and live cattle markets. In the remaining estimations, Newey-West standard errors are used.
***, ** and * denote significance at one, five and ten percent, respectively.

Table 6: Granger causality at individual quantiles: index traders

	COCOA	COFFEE	CORN	COTTON	FEEDER CATLLE	LIVE CATTLE	LEAN HOGS	SUGAR	SRW WHEAT	HRW WHEAT	SOYBEANS	SOYBEAN OIL
Panel A: Granger causality from changes in net long positions (scaled by open interest) to returns:												
$R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1(\theta) * IT_{t-1} + \delta_1^{CV}(\theta) * CV_{t-1} + \varepsilon_t$												
$\theta = 0.05$	-0.08	0.23	-0.62	-0.17	-0.19	0.22	-0.25	-0.54	-0.04	-0.03	0.21	0.39
$\theta = 0.1$	0.37	0.15	-0.86*(**)	-0.29	-0.13	0.12	-0.20(*)	-0.07	-0.14	0.06	-0.19	0.28
$\theta = 0.25$	0.28	0.02	-0.65**(**)	-0.02	-0.06	0.11	-0.09	0.34	-0.20	-0.19	0.09	0.13
$\theta = 0.75$	0.43	-0.25	-0.20	0.001	-0.05	0.11	0.18	0.39	-0.19	0.06	0.40(*)	0.21
$\theta = 0.9$	1.05**(***)	0.17	-0.21	0.02	0.04	0.03	-0.03	0.08	0.08	0.12	-0.05	0.14
$\theta = 0.95$	0.36	0.16	-0.52	-0.07	-0.01	0.09	-0.24	0.01	0.18	0.05	0.42	0.18
Panel B: Granger causality from changes in net long positions (unscaled) to returns:												
$R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1(\theta) * IT_{t-1} + \delta_1^{CV}(\theta) * CV_{t-1} + \varepsilon_t$												
$\theta = 0.05$	0.03	0.26	0.03	0.20	-0.46	0.04	-0.24	-0.13	-0.03	0.43	0.16	0.24
$\theta = 0.1$	0.39*	0.21	-0.01	0.29	-0.30	0.04	-0.04	0.02	-0.09	0.29	0.08	0.19
$\theta = 0.25$	0.16	0.03	-0.06(*)	0.24(*)	0.09	-0.01	-0.02	0.04	-0.06	0.11	0.04	0.07
$\theta = 0.75$	0.07	-0.17	-0.06*(*)	-0.05	-0.38	0.04	0.06	-0.05	-0.04	-0.05	-0.06	0.11
$\theta = 0.9$	-0.04	-0.41(*)	-0.15***(***)	-0.01	0.001	0.05	-0.03	-0.15(**)	-0.08	0.26	-0.16**(*)	0.07
$\theta = 0.95$	-0.35	-0.53	-0.22*(***)	0.08	-0.07	0.02	-0.18	-0.13(*)	-0.20	0.44	-0.22*(*)	-0.02
Panel C: Granger causality from changes in net long positions (scaled by open interest) to returns, other traders included:												
$R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1^{IT}(\theta) * IT_{t-1} + \beta_1^{MM}(\theta) * MM_{t-1} + \beta_1^{OR}(\theta) * OR_{t-1} + \delta_1^{CV}(\theta) * CV_{t-1} + \varepsilon_t$										
$\theta = 0.05$	0.17	0.37	-0.43	0.02	-0.10	0.07	-0.21	-0.52	-0.18	-0.09	0.10	0.09
$\theta = 0.1$	0.37	0.08	-0.71(*)	-0.32*(**)	-0.15	0.15	-0.42	-0.31	-0.16	0.08	0.01	0.39
$\theta = 0.25$	0.17	-0.04	-0.54(**)	0.03	-0.07	0.12	-0.20	0.35	-0.16	0.01	0.22	0.12
$\theta = 0.75$	0.41	0.001	-0.16	0.01	-0.06	0.13	-0.01	0.27	-0.06	0.05	0.15	0.20
$\theta = 0.9$	0.98*(**)	0.01	-0.30	0.04	-0.05	0.09	-0.08	0.14	-0.20	-0.12	0.00	0.25
$\theta = 0.95$	0.65	0.25	-0.06	0.22	-0.10	0.07	0.00	0.22	-0.19	-0.28	-0.14	0.17
Panel D: Granger causality from changes in net long positions (scaled by open interest) to returns, hedgers included:												
$R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1^{IT}(\theta) * IT_{t-1} + \beta_1^{OR}(\theta) * OR_{t-1} + \beta_1^{HP}(\theta) * HP_{t-1} + \delta_1^{CV}(\theta) * CV_{t-1} + \varepsilon_t$										
$\theta = 0.05$	0.34	0.48	-0.88(**)	-0.11	-0.25	0.16	-0.10	-0.73	-0.14	-0.13	-0.10	0.01
$\theta = 0.1$	0.36	0.17	-1.20**(***)	-0.31*	-0.20	0.10	-0.19	-0.40	-0.10	0.01	-0.13	0.34
$\theta = 0.25$	0.30	0.13	-0.50(*)	0.07	-0.16	0.21	-0.18	0.39	-0.20	-0.14	0.19	0.08
$\theta = 0.75$	0.43	0.08	-0.21	0.13	-0.09	0.18(*)	0.07	0.20	-0.10	-0.07	0.38	0.18
$\theta = 0.9$	1.15*(***)	0.08	-0.32	0.09	0.09	0.21(*)	-0.03	-0.14	-0.22	-0.24	0.06	0.06
$\theta = 0.95$	1.12(*)	0.08	-0.11	0.24	0.04	0.38(***)	0.19	0.19	-0.23	-0.58	-0.005	0.14

Note: In Panels A and B, Table 6 shows the coefficient estimate $\beta_1(\theta)$ on lagged changes in net long positions of index traders IT_{t-1} at different quantiles θ of the return distribution (Eq. (8)). In Panel A (B), changes in net long positions scaled by open interest (unscaled in 100 thousand) are considered. The estimation is based on weekly observations from January 10, 2006 to December 31, 2013. The number of observations for every estimation at every quantile amounts to 416.
Panels C and D report the coefficient estimate β_1^{IT} on the lagged changes in net long positions of index traders (Eq. (10) and Eq. (12)). Net long positions are scaled by open interest. The estimation period ranges from June 20, 2006 to December 31, 2013. The number of observations for every estimation at every quantile amounts to 393.
For the inference based on bootstrapped standard errors, ***, ** and * denote significance at one, five and ten percent, respectively. For the inference under the assumption of independent and identically distributed residuals, (***), (**) and (*) denote significance at one, five and ten percent, respectively.

Table 7: Granger causality at individual quantiles: swap dealers

	COCOA	COFFEE	CORN	COTTON	FEEDER CATLLE	LIVE CATTLE	LEAN HOGS	SUGAR	SRW WHEAT	HRW WHEAT	SOYBEANS	SOYBEAN OIL
Panel A: Granger causality from changes in net long positions (scaled by open interest) to returns:												
$\boldsymbol{R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1(\theta) * SW_{t-1} + \delta_1^{CV}(\theta) * CV_{t-1} + \varepsilon_t}$												
$\theta = 0.05$	-0.25	0.64*	-0.13	-0.14	-0.12	0.08	-0.39	0.02	-0.35	0.15	0.16	0.03
$\theta = 0.1$	-0.34	0.23	-0.33	-0.37	0.01	-0.05	-0.20	0.07	-0.23	0.11	-0.28	0.07
$\theta = 0.25$	-0.21	0.11	-0.84**(***)	0.05	0.01	0.14	-0.06	0.36	-0.36*	0.18	-0.20	0.12
$\theta = 0.75$	-0.06	0.10	-0.36	0.03	-0.10	0.13	0.27*	0.17	-0.01	0.05	0.14	0.20
$\theta = 0.9$	-0.07	0.30	-0.39	0.11	0.01	-0.01	-0.14	0.22	0.45	0.07	-0.37	0.15
$\theta = 0.95$	-0.74	0.66*(**)	0.29	0.31	-0.10	0.01	-0.35	0.29	0.45	-0.58	-0.04	0.22
Panel B: Granger causality from changes in net long positions (unscaled) to returns:												
$\boldsymbol{R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1(\theta) * SW_{t-1} + \delta_1^{CV}(\theta) * CV_{t-1} + \varepsilon_t}$												
$\theta = 0.05$	-0.16	-0.21	0.06	-0.06	0.13	0.11	-0.33	0.003	-0.08	0.15	0.16	0.03
$\theta = 0.1$	-0.19	0.08	0.02	0.04	0.53	0.12	-0.06	0.01	-0.09	0.11	-0.28	0.07
$\theta = 0.25$	-0.08	0.14	-0.05	0.03	0.60	0.10	0.02	0.05	-0.10	0.18	-0.20	0.12
$\theta = 0.75$	-0.14	0.02	-0.06(*)	-0.06	-0.48	0.02	0.13	-0.01	0.0004	0.05	0.14	0.20
$\theta = 0.9$	-0.21	0.31	-0.09**(**)	0.003	-0.54	-0.06	0.00	-0.05	0.11	0.07	-0.37	0.15
$\theta = 0.95$	-0.66(*)	0.71(**)	-0.04	0.09	-0.43	-0.10	-0.14	-0.03	0.06	-0.58	-0.04	0.22
Panel C: Granger causality from changes in net long positions (scaled by open interest) to returns, other traders included:												
$\boldsymbol{R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1^{SW}(\theta) * SW_{t-1} + \beta_1^{MM}(\theta) * MM_{t-1} + \beta_1^{OR}(\theta) * OR_{t-1} + \delta_1^{CV}(\theta) * CV_{t-1} + \varepsilon_t}$										
$\theta = 0.05$	-0.28	0.44	0.31	0.03	0.01	-0.07	-0.30	0.29	-0.34	0.32	0.04	0.11
$\theta = 0.1$	-0.23	0.12	-0.25	-0.30	0.001	-0.05	-0.14	-0.03	-0.23	0.13	-0.21	0.01
$\theta = 0.25$	-0.01	-0.03	-0.69**(**)	0.06	-0.01	0.15	-0.18	0.33	-0.28	0.10	-0.21	0.06
$\theta = 0.75$	-0.14	0.24	-0.24	0.00	-0.09	0.08	-0.03	0.17	0.11	0.05	0.07	0.19
$\theta = 0.9$	-0.08	0.04	-0.44	0.04	-0.05	-0.11	-0.28	0.10	0.01	-0.16	-0.17	0.27
$\theta = 0.95$	-0.72	0.56(*)	0.04	0.26	-0.20	-0.01	-0.40	-0.13	-0.11	-0.31	-0.17	0.20
Panel D: Granger causality from changes in net long positions (scaled by open interest) to returns, hedgers included:												
$\boldsymbol{R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1^{SW}(\theta) * SW_{t-1} + \beta_1^{OR}(\theta) * OR_{t-1} + \beta_1^{HP}(\theta) * HP_{t-1} + \delta_1^{CV}(\theta) * CV_{t-1} + \varepsilon_t}$										
$\theta = 0.05$	0.43	0.59	-0.54	0.06	0.05	0.05	-0.15	-0.11	-0.23	-0.08	-0.21	0.02
$\theta = 0.1$	0.09	0.07	-0.31	-0.46(*)	0.07	0.07	-0.11	-0.16	-0.12	0.03	-0.30	-0.13
$\theta = 0.25$	0.05	0.24	-0.74*(**)	0.08	0.002	0.24	-0.11	0.38	-0.36	0.10	-0.23	0.02
$\theta = 0.75$	-0.12	0.33*	-0.39	0.10	-0.13	0.23*	0.09	-0.08	-0.03	-0.04	-0.03	0.19
$\theta = 0.9$	-0.15	0.20	-0.69	0.13	0.03	0.15	-0.14	-0.17	-0.09	-0.16	-0.10	0.02
$\theta = 0.95$	-0.77	0.79*(**)	-0.03	0.44	-0.15	0.13	-0.14	-0.24	-0.10	-0.83	-0.05	0.09

Note: In Panels A and B, Table 6 shows the coefficient estimate $\beta_1(\theta)$ on lagged changes in net long positions of swap traders SW_{t-1} at different quantiles θ of the return distribution. In Panel A (B), changes in net long positions scaled by open interest (unscaled in 100 thousand) are considered. Panel C reports the coefficient estimate β_1^{SW} on the lagged changes in net long positions of swap dealers. Net long positions are scaled by open interest.

The estimation period ranges from June 20, 2006 to December 31, 2013. The number of observations for every estimation at every quantile amounts to 393.

For the inference based on bootstrapped standard errors, ***, ** and * denote significance at one, five and ten percent, respectively. For the inference under the assumption of independent and identically distributed residuals, (***), (**) and (*) denote significance at one, five and ten percent, respectively.

Table 8: Granger causality at individual quantiles: money managers

	COCOA	COFFEE	CORN	COTTON	FEEDER CATTLE	LIVE CATTLE	LEAN HOGS	SUGAR	SRW WHEAT	HRW WHEAT	SOYBEANS	SOYBEAN OIL
Panel A: Granger causality from changes in net long positions (scaled by open interest) to returns:												
$R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1(\theta) * MM_{t-1} + \delta_1^{CV}(\theta) * CV_{t-1} + \varepsilon_t$												
$\theta = 0.05$	-0.45*(***)	-0.09	0.25	-0.11	-0.09	-0.08	-0.04	0.10	0.12	0.13	0.36	0.19
$\theta = 0.1$	-0.21(*)	-0.08	-0.09	-0.17	-0.07	-0.09	-0.17	0.06	-0.06	-0.02	0.08	0.19
$\theta = 0.25$	-0.26**(**)	-0.23**(**)	-0.12	-0.10	0.03	-0.12*(*)	-0.06	-0.06	0.13	-0.04	0.02	0.06
$\theta = 0.75$	0.04	-0.06	0.14	-0.02	-0.005	-0.10***(**)	-0.01	0.29	0.16	0.15	0.05	-0.04
$\theta = 0.9$	0.03	0.02	0.20	-0.08	-0.09*(*)	-0.16**(*)	0.08	0.55*(**)	0.46**(**)	0.08	-0.12	0.12
$\theta = 0.95$	-0.13	-0.34*(*)	-0.002	-0.20	-0.12*(*)	-0.14(*)	0.14	0.15	0.43(*)	0.29	-0.28	0.05
Panel B: Granger causality from changes in net long positions (unscaled) to returns:												
$R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1(\theta) * MM_{t-1} + \delta_1^{CV}(\theta) * CV_{t-1} + \varepsilon_t$												
$\theta = 0.05$	-0.14	-0.09	0.04(*)	0.14(*)	-0.12	-0.003	-0.02	0.09	0.03	0.15	0.06	0.06
$\theta = 0.1$	-0.14(*)	-0.04	0.002	0.06	0.03	-0.02	-0.04	0.01	-0.01	-0.11	0.04	0.06
$\theta = 0.25$	-0.14(*)	-0.14**(*)	-0.01	-0.01	0.07	-0.02	-0.03	-0.01	0.03	-0.06	0.01	0.02
$\theta = 0.75$	-0.01	-0.07	0.01	-0.01	-0.05	-0.03**(*)	-0.01	0.03	0.03	0.01	0.01	-0.01
$\theta = 0.9$	-0.05	-0.04	0.02	-0.06	-0.34**(**)	-0.05*(**)	0.06	0.06(**)	0.11**(**)	0.05	-0.02	0.04
$\theta = 0.95$	-0.23(*)	-0.17	-0.02	-0.02	-0.38**(*)	-0.04	0.08	0.004	0.11	0.21	-0.06	0.01
Panel C: Granger causality from changes in net long positions (scaled by open interest) to returns, other traders included:												
$R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1^{IT}(\theta) * IT_{t-1} + \beta_1^{MM}(\theta) * MM_{t-1} + \beta_1^{OR}(\theta) * OR_{t-1} + \delta_1^{CV}(\theta) * CV_{t-1} + \varepsilon_t$											
$\theta = 0.05$	-0.38*(***)	-0.25	0.38	-0.11	-0.04	-0.17	-0.07	0.06	0.19	0.12	0.35	0.14
$\theta = 0.1$	-0.17	-0.14	0.03	-0.17	0.06	-0.14	-0.29*(*)	0.09	0.02	-0.03	0.19	0.09
$\theta = 0.25$	-0.21*(*)	-0.27**(**)	-0.09	-0.10	0.06	-0.09	-0.13	-0.10	0.17	-0.03	0.06	0.04
$\theta = 0.75$	-0.05	-0.31	0.15	-0.02	0.02	-0.11**(*)	-0.11	0.24	0.12	0.12	0.09	-0.02
$\theta = 0.9$	0.05	-0.20	0.15	-0.08	-0.08*	-0.21***(***)	-0.13	0.53*(**)	0.11	-0.02	-0.25	0.15
$\theta = 0.95$	0.02	-0.17**(**)	-0.03	-0.20	-0.13*	-0.20*(**)	-0.24	0.32	0.07	0.29	-0.41(*)	0.09

Note: Panels A and B show the coefficient estimate $\beta_1(\theta)$ on lagged changes in net long positions of money managers MM_{t-1} at different quantiles θ of the return distribution according to Eq. (8). Panel C reports the coefficient estimate $\beta_1^{MM}(\theta)$ on the lagged changes in net long positions of money managers based on Eq. (10). In Panels A and C, net long positions are scaled by open interest, whereas in Panel B unscaled net long positions (in 100 thousand) are used.
The estimations are based on weekly observations from June 20, 2006 to December 31, 2013. The number of observations for every estimation at every quantile amounts to 393.
For the inference based on bootstrapped standard errors, ***, ** and * denote significance at one, five and ten percent, respectively. For the inference under the assumption of independent and identically distributed residuals, (***), (**) and (*) denote significance at one, five and ten percent, respectively.

Table 9: Granger causality at individual quantiles: other reportables

	COCOA	COFFEE	CORN	COTTON	FEEDER CATLLE	LIVE CATTLE	LEAN HOGS	SUGAR	SRW WHEAT	HRW WHEAT	SOYBEANS	SOYBEAN OIL
Panel A: Granger causality from changes in net long positions (scaled by open interest) to returns:												
$\boldsymbol{R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1(\theta) * OR_{t-1} + \delta_1^{CV}(\theta) * CV_{t-1} + \varepsilon_t}$												
$\theta = 0.05$	0.49	-0.43	1.12(*)	0.42	0.19	-0.003	0.03	0.001	0.07	-0.24	-0.43	-0.31
$\theta = 0.1$	0.39	-0.30	1.03(*)	0.39	0.16	-0.06	-0.14	0.30	0.35	-0.25	0.16	-0.26
$\theta = 0.25$	0.67**(**)	0.19	0.55	0.02	0.07	0.02	-0.45**(**)	-0.27	0.14	0.36	-0.0003	-0.05
$\theta = 0.75$	0.01	-0.52***(**)	0.16	0.01	0.01	-0.09	-0.64***(***)	-0.01	-0.16	0.14	-0.27	0.06
$\theta = 0.9$	0.21	-0.43	-0.26	-0.29	0.10	-0.04	-0.41*(*)	0.02	-0.86*(**)	0.42	-0.40	0.01
$\theta = 0.95$	0.46	-0.59(*)	-0.89*	-0.48	0.22(*)	-0.20	-0.24	0.02	-1.72***(***)	0.33	-0.72*	0.12
Panel B: Granger causality from changes in net long positions (unscaled) to returns:												
$\boldsymbol{R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1(\theta) * OR_{t-1} + \delta_1^{CV}(\theta) * CV_{t-1} + \varepsilon_t}$												
$\theta = 0.05$	0.15	-0.39(*)	0.10*(*)	0.20	0.59	-0.001	0.01	0.01	0.01	-0.19	-0.05	-0.14
$\theta = 0.1$	0.21	-0.19	0.09**(**)	0.19	0.44	-0.02	-0.06	0.05	0.09	-0.15	0.03	-0.08
$\theta = 0.25$	0.38**(*)	0.15	0.04	-0.002	0.22	0.01	-0.19**(**)	0.01	0.03	0.35(*)	-0.005	-0.01
$\theta = 0.75$	0.01	-0.36(**)	0.01	-0.01	0.02	-0.03	-0.27***(***)	-0.06	-0.03	0.09	-0.07	0.02
$\theta = 0.9$	0.12	-0.29**	-0.01	-0.15	0.35	-0.01	-0.19*	-0.002	-0.24**(**)	0.22	-0.02	-0.04
$\theta = 0.95$	0.22	-0.45(*)	-0.07	-0.24	0.76*(**)	-0.06	-0.13	-0.001	-0.41**(***)	0.23	-0.14*	0.03
Panel C: Granger causality from changes in net long positions (scaled by open interest) to returns, other traders included:												
$\boldsymbol{R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1^{IT}(\theta) * IT_{t-1} + \beta_1^{MM}(\theta) * MM_{t-1} + \beta_1^{OR}(\theta) * OR_{t-1} + \delta_1^{CV}(\theta) * CV_{t-1} + \varepsilon_t}$											
$\theta = 0.05$	0.21	-0.63	0.92	0.43	0.09	-0.13	-0.02	0.38	0.23	0.05	-0.05	-0.32
$\theta = 0.1$	0.70(*)	-0.51	0.86	0.58	0.23(*)	-0.19	-0.46*(*)	0.28	0.17	-0.23	0.40	-0.08
$\theta = 0.25$	0.66(*)	-0.08	0.55	-0.03	0.09	-0.08	-0.43**(**)	-0.03	0.13	0.36	0.15	0.02
$\theta = 0.75$	0.04	-0.74**(**)	0.27	-0.11	0.02	-0.13	-0.58***(***)	-0.10	-0.04	0.27	-0.32	0.04
$\theta = 0.9$	0.09	-0.52	-0.59	-0.42	0.06	-0.21**(*)	-0.50*(*)	0.14	-0.85*(*)	0.40	-0.49	0.07
$\theta = 0.95$	0.31	-0.50	-0.92	-0.62	0.07	-0.29*(**)	-0.48(*)	0.50	-1.84***(***)	0.56	-0.95*	0.21
Panel D: Granger causality from changes in net long positions (scaled by open interest) to returns, hedgers included:												
$\boldsymbol{R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1^{IT}(\theta) * IT_{t-1} + \beta_1^{OR}(\theta) * OR_{t-1} + \beta_1^{HP}(\theta) * HP_{t-1} + \delta_1^{CV}(\theta) * CV_{t-1} + \varepsilon_t}$											
$\theta = 0.05$	0.85(*)	-0.38	0.63	0.38	0.10	-0.003	-0.02	0.16	0.43	-0.26	0.20	-0.42
$\theta = 0.1$	0.86(**)	-0.33	0.83(*)	0.54(*)	0.15	-0.08	-0.25	0.27	0.19	-0.33	0.40	-0.12
$\theta = 0.25$	0.90*(***)	0.21**(**)	0.68*(*)	0.004	0.05	0.03	-0.33*(*)	0.08	-0.07	0.27	0.18	-0.05
$\theta = 0.75$	0.04	-0.57	0.11	-0.07	-0.02	0.01	-0.52***(***)	-0.09	-0.12	0.11	-0.24	0.11
$\theta = 0.9$	-0.27	-0.34	-0.74	-0.34	0.11	0.05	-0.40*(*)	-0.16	-0.96**(**)	-0.01	-0.47	-0.14
$\theta = 0.95$	0.39	-0.53	-1.00	-0.58	0.17	0.01	-0.10	0.21	-1.87***(***)	-0.17	-0.90*(*)	0.23

Note: Panels A and B show the coefficient estimate $\beta_1(\theta)$ on lagged changes in net long positions of other reportables OR_{t-1} at different quantiles θ of the return distribution according to Eq. (8). Panels C and D report the coefficient estimate $\beta_1^{OR}(\theta)$ on the lagged changes in net long positions of other reportables based on Eq. (10) and Eq. (12). In Panels A, C and D, net long positions are scaled by open interest, whereas in Panel B unscaled net long positions (in 100 thousand) are used.
The estimations are based on weekly observations from June 20, 2006 to December 31, 2013. The number of observations for every estimation at every quantile amounts to 393.
For the inference based on bootstrapped standard errors, ***, ** and * denote significance at one, five and ten percent, respectively. For the inference under the assumption of independent and identically distributed residuals, (***), (**) and (*) denote significance at one, five and ten percent, respectively.

Table 10: Granger causality at individual quantiles: hedgers

	COCOA	COFFEE	CORN	COTTON	FEEDER CATLLE	LIVE CATTLE	LEAN HOGS	SUGAR	SRW WHEAT	HRW WHEAT	SOYBEANS	SOYBEAN OIL
Panel A: Granger causality in mean from changes in net long positions (scaled by open interest) to returns: $R_t = \alpha + \gamma_1 * R_{t-1} + \beta_1^{IT} * IT_{t-1} + \beta_1^{OR} * OR_{t-1} + \beta_1^{HP} * HP_{t-1} + \delta_1^{CV} * CV_{t-1} + \varepsilon_t$												
β_1^{HP}:	-0.16*	-0.14*	0.16	-0.04	0.04	-0.17***	-0.12	0.13	0.07	0.12	-0.07	0.04
	(0.08)	(0.08)	(0.15)	(0.06)	(0.05)	(0.05)	(0.09)	(0.13)	(0.12)	(0.10)	(0.09)	(0.05)
Panel B: Granger causality at individual quantiles from changes in net short positions (scaled by open interest) to returns: $R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1^{IT}(\theta) * IT_{t-1} + \beta_1^{OR}(\theta) * OR_{t-1} + \beta_1^{HP}(\theta) * HP_{t-1} + \delta_1^{CV}(\theta) * CV_{t-1} + \varepsilon_t$												
$\theta = 0.05$	-0.38*(**)	-0.25	0.58	0.09	0.07	-0.19	-0.14	0.35	-0.19	0.23	0.27	0.12
$\theta = 0.1$	-0.23*(**)	-0.04	0.35	0.08	0.12	-0.15(*)	-0.12	0.06	-0.12	0.09	0.08	0.07
$\theta = 0.25$	-0.28***(***)	-0.25**(**)	-0.08	-0.06	0.14*(*)	-0.19**(**)	-0.10	-0.04	0.02	0.11	0.03	0.05
$\theta = 0.75$	-0.01	-0.12	0.14	-0.07	0.05	-0.13**(**)	-0.12	0.14	0.14	0.12	0.02	0.05
$\theta = 0.9$	-0.11	-0.11	0.23	-0.07	-0.11	-0.26***(***)	-0.31*(**)	0.38*(*)	0.07	0.22	-0.28**	0.19**(**)
$\theta = 0.95$	-0.25	0.004	0.05	-0.12	-0.20	-0.41***(***)	-0.63**(***)	0.19	0.05	0.43	-0.43*(**)	0.12

Note: Panel A reports the coefficient estimate β_1^{HP} on lagged changes in net short positions of producers/merchants/processors/users HP_{t-1} in estimations based on Eq. (11). Standard errors are reported below the coefficient estimates in parentheses. OLS standard errors are used in cocoa, coffee and lean hogs markets. White standard errors are used in feeder and live cattle markets. In the remaining estimations, Newey-West standard errors are used. ***, ** and * denote significance at one, five and ten percent, respectively.
Panel B reports the coefficient estimate $\beta_1^{HP}(\theta)$ on the lagged changes in net short positions HP_{t-1} for the Granger causality at individual quantiles (Eq. (12)). For the inference based on bootstrapped standard errors, ***, ** and * denote significance at one, five and ten percent, respectively. For the inference under the assumption of independent and identically distributed residuals, (***), (**) and (*) denote significance at one, five and ten percent, respectively.

Impact of Speculation on Precious Metals Futures Markets

Published in Resources Policy, 44, 118-134 (DOI: 10.1016/j.resourpol.2015.02.006).

David Bosch
Humboldt University of Berlin
Institute of Finance
david.bosch@wiwi.hu-berlin.de

Elina Pradkhan
Humboldt University of Berlin
Institute of Finance
elina.pradkhan@hu-berlin.de

Abstract

Existing research finds little evidence that speculative activity in futures markets has any impact on precious metals' spot prices. We examine whether speculators' positions predict returns and return volatility in precious metals futures markets. We use two proxies for speculative activity: non-commercial traders and money managers. Money managers are a subcategory of non-commercial traders that is associated with professional speculators. Our analysis distinguishes between short- and long-term dynamics. Whereas we cannot confirm any short-term impact of speculators on returns and conditional volatility in the period after 2006, the weekly changes in non-commercial traders' positions appear to have a destabilizing impact on subsequent conditional volatility in gold, silver and palladium futures markets in the period prior to June 2006. Moreover, we cannot rule out a long-term, potentially destabilizing, impact on returns when accumulated positions of speculators over monthly horizons are considered.

JEL Classification: Q02, G12, G13, D84

Keywords: precious metals futures markets, speculation, Granger causality

Information Content of Trading Activity in Precious Metals Futures Markets

Published in Journal of Futures Markets, 36, 421-456 (DOI: 10.1002/fut.21755).

Elina Pradkhan

Humboldt University of Berlin
Institute of Finance
elina.pradkhan@hu-berlin.de

Abstract

This study examines the predictive power of trading activity for returns in precious metals futures markets. Based on a Markov switching model, two market regimes are distinguished: "bull" markets that are characterized by rising prices and a low return volatility and "bear" markets that are associated with negative mean returns and a high return variability. There is robust evidence of significant Granger-causal effects from trading activity to returns in "bull" and "bear" markets that are not detected by models without regime switching. Moreover, the relationship between trading activity and subsequent returns is often asymmetric in different market regimes.

JEL classification: Q02, G12, G13, D84
Keywords: futures returns, trading volume, open interest, speculation, non-linear causality

Acknowledgements: I thank the anonymous reviewers and the editor, Robert I. Webb, for very helpful suggestions and comments.

Erklärung über genutzte Hilfsmittel gemäß § 12 Abs. 4:

Ich bezeuge durch meine Unterschrift, dass meine Angaben über die bei der Abfassung meiner Dissertation benutzten Hilfsmittel, über die mir zuteil gewordene Hilfe sowie über frühere Begutachtungen meiner Dissertation in jeder Hinsicht der Wahrheit entsprechen.

Frankfurt, 01.10.2015

Elina Pradkhan